Corridor Management Pilot Projects

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16. Abstract

Managing existing and newly constructed highway corridors has recently become a significant concern in many states, including Iowa. As urban land and land on the urban fringe develops, there is pressure to add features such as commercial driveways, at-grade public road intersections, and traffic signals to arterial highway routes that should primarily serve high-speed traffic. This diminishes the speed and traffic capacity of such roadways and can also cause significant safety issues. If mobility and safety are diminished, the value of the highway investment is diminished. Since a major highway corridor improvement may cost tens of millions of dollars or more, corridor management is as critical to preserving that investment as such more "hard side" management practices as pavement or bridge management.

Corridor management is a process that applies access management principles to highway corridors in an attempt to balance the competing needs of traffic service, safety, and support for land development. This project helped to identify routes that should be given high priority for corridor management. The pilot study in the form of two corridor management case studies provides an analytical process that can be replicated along other Iowa commuting corridors using commonly available transportation and land use data resources. It also offers a general set of guidelines for the Iowa Department of Transportation to use in the development of its own comprehensive corridor management program.

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CORRIDOR MANAGEMENT PILOT PROJECTS

CTRE Project 02-125

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The Des Moines Area Metropolitan Planning Organization, Polk County, City of Pleasant Hill, and Jasper County provided a number of useful digital and paper data sources for the IA 163 case study. The East Central Intergovernmental Association (ECIA) provided a considerable amount of data for the US 20 case study. Dubuque County also provided very valuable assistance with digital data and land use plan documents.

Two consulting firms working on projects along US 20 in Dubuque County—HDR, Inc. and the Howard R. Green Company—also provided useful information and insights.

INTRODUCTION

Managing existing and newly constructed highway corridors has recently become a significant concern in many states, including Iowa. As urban land and land on the urban fringe develops, there is pressure to add features such as commercial driveways, at-grade public road intersections, and traffic signals to arterial highway routes that should primarily serve high-speed traffic. This diminishes the speed and traffic capacity of such roadways and can also cause significant safety issues. Corridor management is a process that applies access management principles to highway corridors in an attempt to balance the competing needs of traffic service, safety, and support for land development. In Iowa, there has been growing interest in managing major highway corridors that serve as commuting routes in and near metropolitan areas and other large urban areas. This project follows up on an earlier project, “Process to Identify High-Priority Corridors for Access Management Near Large Urban Areas in Iowa” (Plazak and Souleyrette 2002). This project helped to identify routes that should be given high priority for corridor management.

This pilot study (in the form of two corridor management case studies) was intended to provide an analytical process that can be replicated along other Iowa commuting corridors using commonly available transportation and land use data resources. It was also intended to develop a general set of guidelines for the Iowa Department of Transportation (Iowa DOT) to use in the development of its own comprehensive corridor management program.

WHAT IS ACCESS MANAGEMENT?

Highways play two major and sometimes conflicting roles—providing mobility for travelers and goods and providing access to adjacent and nearby land and land development. These roles vary considerably with the functional level of the roadway system. On local roads and streets, the emphasis is on providing direct land access. On Interstates, freeways, and other arterials, the emphasis is (and should be) on serving mobility for passengers and freight. Access management involves striking a safe and efficient balance between the mobility and land access roles that all roadways must play.

Unfortunately, there is often pressure to provide too much direct access to land development along arterial highway corridors both inside and adjacent to urban and metropolitan areas. This is because direct land access from an arterial can be valuable for an individual landowner or developer. However, allowing too much direct access to land from arterial roadways can generate a number of problems, including the following:

- Delays, congestion, and reduced travel speed for commuters and through travelers. Excessive direct access leads to poorer operational performance on major arterial roadways.
- Air quality and excess energy consumption problems associated with increased “stop and go” traffic.

- Increased crash rates, injury rates, and crash costs. Too much direct access tends to increase certain types of crashes, including rear-end collisions, left-turning crashes, and right-turn collisions at driveway locations. Iowa research and research around the nation has generally shown that well-managed roadways are roughly 40 to 50 percent safer than poorly-managed routes. The crash costs savings of access management can be very significant, especially in areas with large amounts of commercial land development (Maze and Plazak 1997).

On the other hand, research in Iowa and other parts of the country shows that access management projects are relatively benign in terms of their impact on adjacent commercial businesses and land development. Some individual businesses (usually a very small percentage of the total) may be negatively impacted, but the corridor as a whole performs well economically after access management has been increased (Maze and Plazak 1997).

WHAT IS CORRIDOR MANAGEMENT?

Corridor management is a systematic process for managing access along an extended highway corridor, often a major arterial route traversing a metropolitan area or a rural arterial route that serves an economic region of a state. Corridor management involves such considerations as follows:

- The location and spacing of interchanges with other public roadways
- The location and spacing of at-grade intersections with other public roadways, including traffic signals and other traffic control devices
- The location and configuration of medians and median breaks
- The location and spacing of private driveways
- Alternative access ways, such as frontage and backage roads
- The location and design of dedicated left and right turning lanes
- Coordination of the transportation facility with surrounding land development, land use planning, zoning, and internal traffic circulation system

The main idea behind corridor management is that of preserving mobility and safety, which are the main economic benefits of a major investment in highways. If mobility and safety are diminished, for instance through allowing too much direct access to land from an arterial highway corridor, the value of the highway investment is diminished. Since a major highway corridor improvement may cost tens of millions of dollars or more, corridor management is as critical to preserving that investment as such more “hard side” management practices as pavement or bridge management.

In extreme situations, a series of poor access management decisions may lead to an entire corridor becoming unsuitable for serving mobility needs. An example in Iowa is US Highway 30 running to the south of Marshalltown. On that corridor, access was not carefully managed, resulting in a corridor with a high commercial driveway density, a relatively high crash rate, and a low travel speed. Eventually, a limited access bypass had to be built to replace the existing route. This cost millions of dollars that might not have needed to be spent if more attention had been paid in previous decades to corridor management.

A number of states, for example Colorado, Florida, Kansas, Minnesota, and Oregon have elaborate corridor management programs in place. In some of these states, there is an access management statute that gives the state DOT extensive powers to manage corridors. The Iowa (DOT) does not have as elaborate a corridor management statute or system but has practiced access management on the highways it owns and operates for a number of years. The Iowa DOT manages access along corridors in a number of ways, including the following:

- Purchasing access rights from landowners along selected routes
- Maintaining an access priority classification system, which runs from complete access control on Interstates and Other Freeways (Category 1) through routes with essentially no access control (Category 6)
- Having access considerations (such as driveway geometric design) integrated into its roadway design standards
- A Corridor Preservation Program that allows the Iowa DOT to review proposed land use changes along selected highway corridors where a major investment is being planned in the future

Corridor management can be a very challenging set of activities. This is the case because corridor management involves both transportation and land use issues. Many access-related problems are actually generated and must be solved beyond the highway right-of-way line. Transportation organizations at the state and local level must work together to manage corridors. The same applies to land use planning organizations at the local level. The best corridor management programs are state and local partnerships formalized through intergovernmental agreements. Since land development is primarily a private sector activity regulated by the public sector, stakeholder education and involvement is also critical to success. Regional and metropolitan planning organizations can play an important role as a “bridge” between all the parties.

PREVIOUS RELEVANT IOWA RESEARCH AND OUTREACH PROJECTS

The Iowa DOT has funded the completion of a number of research and outreach projects related to access management over the past decade. These projects include the following:

- A body of research on the safety, traffic flow, and business impacts of access management projects
- Tools for planning, designing, and promoting access management, including an access management handbook and toolkit, an access management web site, an access management conference, an access management design standards for local governments, and a popular access management videotape. (Search the Center for Transportation Research and Education Web Site http://www.ctre.iastate.edu

under keyword "Access Management" for more information about these products and previous research.)

The most recent access management research projects that the Iowa DOT has supported include the following:

- A project in which the Des Moines Metropolitan Planning Organization is developing an access management plan and program for the arterial roadways in its planning area. This project is currently in progress and will be completed during 2004.
- A project funded by the Midwest Transportation Consortium (MTC) that is quantifying in dollar terms the impact of good and poor access management practices on the value of highway corridor alignments. This project is also currently in progress and will also be completed during 2004.

In 2002, a study to identify high priority corridors for access management was completed. This study focused on routes that serve considerable commuting activity near Iowa's metropolitan areas and other large urban areas. One key finding of this study was that about 20 percent of crash costs along Iowa's major intercity highway corridors could be attributed to access-related activity, even in rural areas. (The other 80 percent of crashes involve such events as run off the road crashes and animal/vehicle crashes that clearly cannot be linked to land development.) The percentage of access-related crashes varied considerably in terms of geography. Many of the access-related crashes are concentrated in a few Iowa DOT Districts (Districts number 1 and 5 in particular) and near a few metro and urban areas (the Central Iowa metro areas of Des Moines and Ames in particular). Inside urban areas, access-related crashes represent 40 to 50 percent of all crashes.

In the access priority study, there was a special emphasis placed on identifying four-lane highway corridors that were likely to have future access management problems due to a combination of high driveway density, high forecast traffic, high levels of commuting activity, and close proximity to an urban area. A number of these so-called "pro-active corridors" were identified as corridors where the Iowa DOT would likely get a good return on investment from access management measures.

SELECTION OF CORRIDOR MANAGEMENT PILOT PROJECTS

A committee made up of representatives of the Iowa DOT's Highway Division, representing highway development and traffic safety professionals, met to select two of the "pro-active corridors" identified in the previous research study for the purposes of a pilot corridor management study.

The two pilot corridors selected were the following:

- US Highway 20 between Devon Drive in the City of Dubuque and the Dubuque County border with Delaware County at Dyersville
- IA Highway 163 between the border between the Cities of Des Moines and Pleasant Hill and the City of Monroe in Jasper County

These two corridors were selected to provide for geographic coverage in that one is in Central Iowa near a large metropolitan area and one is in Northeast Iowa near a smaller metropolitan area. Both corridors have a variety of adjacent land use, from urban commercial to cropland. Both of them are in areas where substantial land development pressure is expected over the next twenty years. Both corridors are designated on the Iowa DOT's Commercial Industrial Network (CIN) and on the National Highway System (NHS). These designations indicate that both routes should mainly be developed and maintained to serve high-speed, through traffic. Direct access to land should be given a lower priority.

Commuting distances in Iowa are relatively long. However, mean travel speeds are high, so commuting times are actually short by national standards. Half-hour, 30 mile commutes are rather common; many commuters live even farther away from their workplace. The new long-range transportation plan for Iowa will indicate that commuting distances and times in Iowa are growing. For this reason, the pilot corridors were analyzed outward to a distance of 25 to 30 miles from the urban center.

ANALYSIS PROCESS

Both the US 20 and IA 163 corridors were analyzed in three ways, which included the following:

- Segmentation. Both corridors were divided in to three distinct segments: an already developed urban arterial segment (called Segment 1), a currently developing urban fringe/suburban segment (Segment 2), and a rural segment that might come under limited development pressure in the long-term (Segment 3). Segmentation was conducted to highlight the differences in safety and land use issues as well as potential corridor management solutions in urban, urban fringe/suburban, and rural areas (see Figure 1).
- A safety analysis. Recent Iowa crash records were queried to produce a crash database for each corridor segment that only included probable access-related crashes. These included right-turn, left-turn, and rear end collisions. Inside urban areas, such crashes typically represent half of all crashes. In rural areas, such crashes are a much smaller proportion of total crashes—perhaps twenty percent of the total. In rural areas, run off the road crashes and animal/vehicle crashes tend to be more significant than access-related crashes.
- A current land use analysis. Land use data were obtained from the county assessor or other sources.

- A future land use analysis. Land use plans (if available) from local governments were analyzed for corridor management implications. For the two pilot corridors, one land use plan (US 20) was available in a digital geographic information system analysis, which facilitated analysis. On the Iowa 163 corridor, land use planning information was more limited. In fact, one major suburban community in the middle of the corridor had no current land use plan.

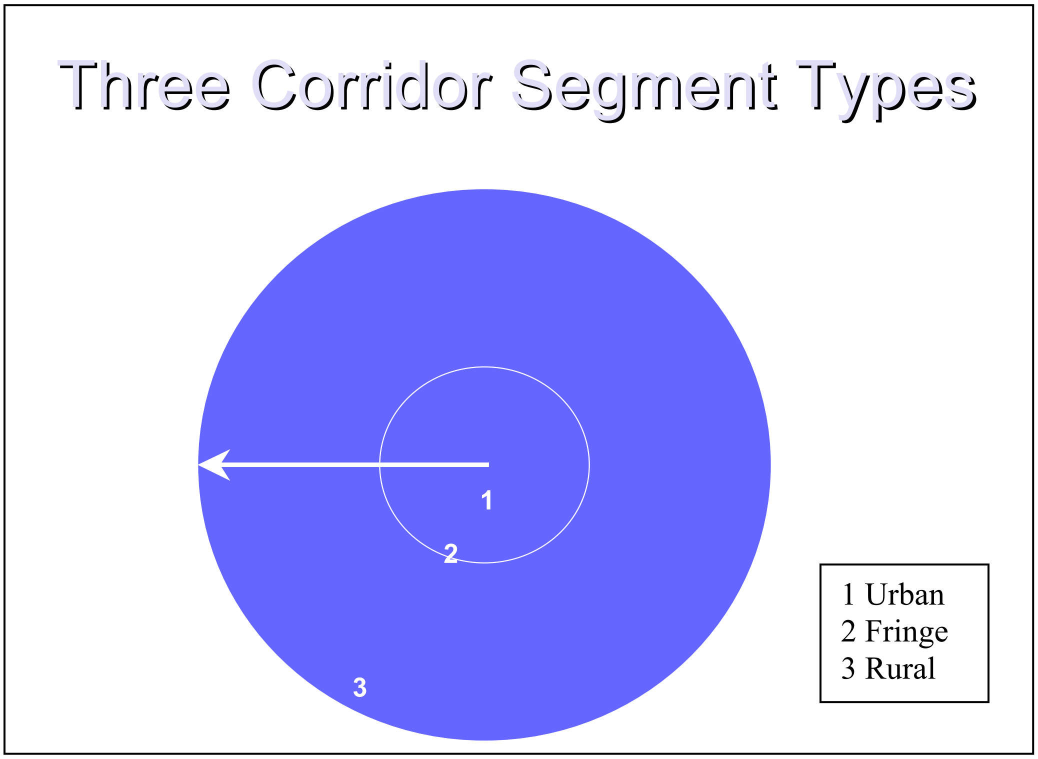

Figure 1. Corridor segment types

The results of the three analyses were considered together to develop a set of typical present and future access-related issues for Iowa corridors. Three issue categories were identified, as follows:

- Current access-related safety and operational issues.
- Current land development-related issues.
- Emerging future issues. Emerging issues were generally situations in which anticipated land development would likely lead to future access management issues. A ten- to twenty-year land use planning horizon was utilized.

ANALYSIS RESULTS

The results of the corridor management analysis process for the US 20 and IA 163 pilot projects indicate that both corridors have some current safety and land use coordination problems. None of these problems might be termed severe. Of the two, Segment 1 of US

20 (the most urban portion of the corridor within the City of Dubuque) has the most pressing current problems. These problems are not, however, primarily due to a high density of private driveway accesses to US 20; instead, most of the problems stem from close spacing of major signalized public road intersections. This finding serves as a reminder that access management is not just a matter of controlling private driveways. Detailed analyses for US 20 and IA 163 are contained in Appendices A and B of this report.

Both the US 20 and IA 163 corridors have great potential for safety problems to become magnified in future years as more commercial and industrial development occurs along the routes. In particular, both of the routes have segments (Segment 2 of each route) that transition through a fringe area between urban and rural. The proposed land development plans for Segment 2 of IA 163, which basically involves a strip commercial development between the US 65 interchange at Pleasant Hill east to Southeast Polk High School, is of most concern. Strip commercial development rather than commercial development concentrated at selected interchanges or intersections raises the possibility of an entire corridor choked with access-related problems.

Typical Corridor Management Problems Identified In the Two Pilot Corridors

Both of the pilot corridors exhibited similar characteristics in terms of traffic volumes, travel speeds, and crash rates. Volumes, overall crash rates, and access-related crash rates were by far the highest in urban portion of the corridor (Segment 1). Crash rates and traffic volumes fell dramatically, and travel speeds rose in Segments 2 and 3. Driveway densities and traffic signal densities were far higher in Segment 1 than Segments 2 and 3 for both corridors. Detailed corridor management issues are shown below by segment type.

Segment 1 On US 20 and IA 163

- Largely built-out in terms of commercial development; some potential for new development along IA 163
- Relatively high commercial driveway and traffic signal densities
- Relatively high rates of access-related crashes and rear-end collisions near traffic signals
- IA 163 Segment 1 much better managed than US 20 Segment 1
- Frontage roads exist, but are discontinuous and located too close to the mainline
- Lack of dedicated turning lanes
- Some direct driveway accesses that could be easily consolidated and/or closed

Segment 2 on US 20 and IA 163

- A mixture of commercial, industrial, and agricultural land use
- Large potential for new commercial and industrial development
- Relatively low access-related crash rates except around the few traffic signals; rear-end collisions predominate

- Relatively low traffic signal density and relatively high travel speed
- A few concentrations of high commercial driveway densities that are of particular safety concerns
- Few established alternative access ways (e.g., frontage or backage roads)
- High likelihood of more access-related problems in the future due to the roadway configuration and the high potential for new land development

Segment 3 on US 20 and IA 163

- Mainly agricultural land uses with a few small municipalities (mainly residential and limited commercial and industrial uses)
- Lack of land use planning in both the small cities and rural areas along the corridor
- Some potential for new commercial and residential development in and near the municipalities
- Very well managed access on both US 20 and IA 163
- A few existing or potential spot access problems around key at-grade intersections

RECOMMENDED CORRIDOR MANAGEMENT POLICIES AND PROGRAMS

The Iowa DOT already has in place many policies and programs that encourage corridor management and access management. However, other potential policy options exist that could make the Iowa DOT's program even more effective than it is now. Table 1 recommends approaches by the type of corridor segment involved.

Table 1. Recommended corridor management approaches

Situation	Description	Recommended Approaches
Segment 1 Situations (Urban)	Within the urban area, largely built-out, with many existing access management problems	Develop detailed access management plans; retrofit access management to improve safety and traffic flow
Segment 2 Situations (Fringe)	Fringe within 10 to 15 miles of the urban area, prone to development pressure, with some existing access management problems	Develop a corridor management 28-E agreements; purchase access rights where possible; apply the Iowa DOT Corridor Preservation Program if applicable
Segment 3 Situations (Rural)	Rural, but in the 30 minute "commuter zone;" spot access management problems may develop in selected locations; well-managed at present; few existing access management problems	Preserve well-managed access that exists now; encourage coordinated land use planning with concentrated commercial land development; upgrade access priority classification where appropriate

The corridor management activities relevant for each segment type (1 = urban, 2 = urban fringe/suburban, 3 = rural "commuter zone") are described below. Some corridor management program activities are relevant for high priority corridors in any zone.

Segment 1 Activity Descriptions

The following activities will be most appropriate along the already urbanized portions of corridors.

- **Develop and implement retrofit plans for urban segments**. Develop detailed access management retrofit plans for urban segments of corridors such as Segments 1 on US 20 and IA 163. These plans should include such elements as new raised medians, driveway consolidation, corner clearance, frontage and backage roads, improved internal circulation in adjacent land developments, traffic signal spacing (including removal if warranted), traffic signal system optimization, and installation of dedicated turning lanes. Appendices A and B of this report suggest some detailed measures that could be taken along the US 20 and IA 163 pilot corridors.

Segment 2 Activity Descriptions

The following activities will be most useful along "urban fringe" portions of corridors.

- **Develop and implement access management intergovernmental agreements**. Develop corridor management 28-E agreements with municipalities along selected corridors where extensive future land use change is expected. A model agreement is included in Appendix C of this report. This agreement was recently developed and implemented for US Highway 6 on the western suburban edge of the Des Moines metropolitan area. A good corridor management 28-E agreement will include detailed discussions of such matters as traffic signal spacing, dedicated turning lanes, medians, acceptable driveway access points, and alternative access ways in adjacent land developments (e.g., frontage and backage roads). The US 6 agreement covers all these features. A forthcoming National Cooperative Highway Research Program (NCHRP) Synthesis report on "Cooperative Agreements For Arterial Corridor Management" will serve as an additional reference for the development of such corridor management intergovernmental agreements.

- **Make access rights purchases where feasible.** Begin a targeted program to purchase access rights from private landowners along selected arterial highways. In situations such as on Segments 2 (the Urban Fringe Segments) on both US 20 and IA 163, there is considerable land development pressure expected in the near future. This sort of situation—where access purchases could still be made and there is a considerable risk of future access management safety and operational problems—is where access rights purchases would be most effective. These areas would likely be found on corridors that radiate outward from metropolitan areas and which are within about half hour travel time of the center of the metro area.

- **Apply the Iowa DOT Corridor Preservation Program where appropriate.** The Iowa DOT's existing Corridor Preservation Program in additional locations is appropriate. This program allows the Iowa DOT to review any proposed land development and zoning changes within a prescribed area near a highway corridor project that is expected to be developed in the future. Portions of US 20 (essentially Segment 2 in this study) are already covered by Corridor Preservation Program at present. This is an excellent tool for the DOT to use to coordinate with local land use planning agencies when a major investment in the corridor is anticipated. Plans have been developed to upgrade US 20 to an access-controlled freeway from Dubuque to Peosta. However, the project is expensive, and the financial resources to do it are not available in the current Iowa DOT Five Year Program.

Segment 3 Activity Descriptions

Finally, the following activities will be most appropriate along rural portions of commuter routes.

- **Preserve existing high levels of access control.** Both Segments 3 on the two pilot corridors are examples of well-managed highway access. These segments need to be protected by not allowing excess access points to be approved and developed. One way to accomplish this is to encourage any new land development that occurs near communities along the corridor to be concentrated near interchanges and not near at-grade intersections. This should be done through consultations with municipalities. In addition, median breaks should be carefully managed. If left-turning conflicts become a problem, closure of median breaks or the installation of a three-quarter or another restrictive access should be considered.

Overall Corridor Management Program Activity Descriptions

- **Access priority classification review**. Improve the existing GIS-based database of Iowa DOT access classifications, particularly along the National Highway System (NHS) and/or Commercial Industrial Network (CIN). When this inventory is completed, examine the access classification of routes to determine if they are correctly classified given planned development of the roadway system and anticipated land use change.

- **Driveway inventory.** Develop a complete inventory of driveways along the Iowa DOT system (CIN and/or NHS in particular), including farm field accesses that could be transformed into commercial or residential driveways as land use changes occur. One economical way to inventory driveways is to use high-resolution remote sensing imagery. Iowa now has statewide one-meter resolution digital color orthophoto coverage that is especially useful for identifying driveway locations in suburban and rural areas. Vegetation appears in red on the orthophoto, while pavements and dirt roads appear in shades of gray.

- **Automated driveway permitting system.** Consider an automated access permitting system similar to that being developed by the Kansas DOT. This sort of tool would allow access permits along the state highways to be reviewed more thoroughly and consistently.

- **Iowa DOT design standards.** Develop and adopt a more extensive system of Iowa DOT design standards regarding access management, corridor management, and driveway design. Several nearby states, including Kansas and Missouri, have extensive access management/corridor management design standards documents that could be used as models for Iowa.

- **Consistent statewide urban design standards.** Encourage local governments in Iowa to use the Statewide Urban Designs and Specifications (SUDAS). SUDAS contain a large section that explains the need for access management and that also suggests access management design treatments and standards. The access management section of SUDAS is scheduled to be improved over the next several years.

- **Access management project plan elements.** Require that all new capacity and reconstruction projects along Iowa DOT arterial routes have an access management component in their design. For new capacity improvements, emphasis would be placed on minimizing direct access to the roadway. For reconstruction, emphasis would be placed on retrofitting access management, for example minimizing traffic signals, increasing driveway spacing, and adding raised medians in urban areas.

- **Local land use planning.** Many local jurisdictions in Iowa—even some in fast-growing regions of the state—lack up-to-date land use plans. Encourage all local jurisdictions (through such partners as the Iowa Department of Economic Development/City Development Board, Iowa State University Extension to Communities, Iowa State Association of Counties, and Iowa League of Cities) to prepare and/or update comprehensive land use plans and land development ordinances. This is especially important for cities and counties in metropolitan areas and within a half hour drive of metro areas. Several of the cities along the US 20 and IA 163 pilot corridors had either no or very outdated land use plans.

- **Metropolitan access management planning.** Encourage all Metropolitan Planning Organizations (MPOs) address access management and corridor management in their long-range transportation plans. Encourage MPOs to incorporate access management into their project programming and prioritization process. The Des Moines Area MPO is currently working on both of these actions and can be used by other MPOs as a model. These efforts need to include access management, access problem identification, education of stakeholders and elected decision-makers, programming, and coordination of transportation and land use planning.

CONCLUSIONS

In April 2004, the analysis and conclusions from this study were presented to the Iowa DOT's Highway Division Management Team, which includes managers from the Iowa DOT Headquarters and District Offices. This presentation resulted in the initiation of corridor management initiative, which will involve all the Iowa DOT District Offices. This presentation is included in Appendix D of this report.

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APPENDIX A: US 20 DUBUQUE 20 CORRIDOR MANAGEMENT ANALYSIS AND PROPOSED APPROACHES

Project Area Land Use and Traffic Conditions

Corridor conditions

For this study, U.S. 20 was split into three segments according to land use. Segment One, from Devon Drive to Northwest Arterial, lies in the urban setting of the City of Dubuque. Segment Two extends approximately 7.5 miles west of Northwest Arterial to Peosta. It is identified as the developing or suburban segment for the study, due to growth along U.S. 20 from the City of Dubuque. Segment Three is approximately 15 miles long extending from Peosta to Dyersville. Segment Three is distinguished from the other segments because of the rural setting along the corridor. Figure A.1 shows a map of the corridor study area by segment.

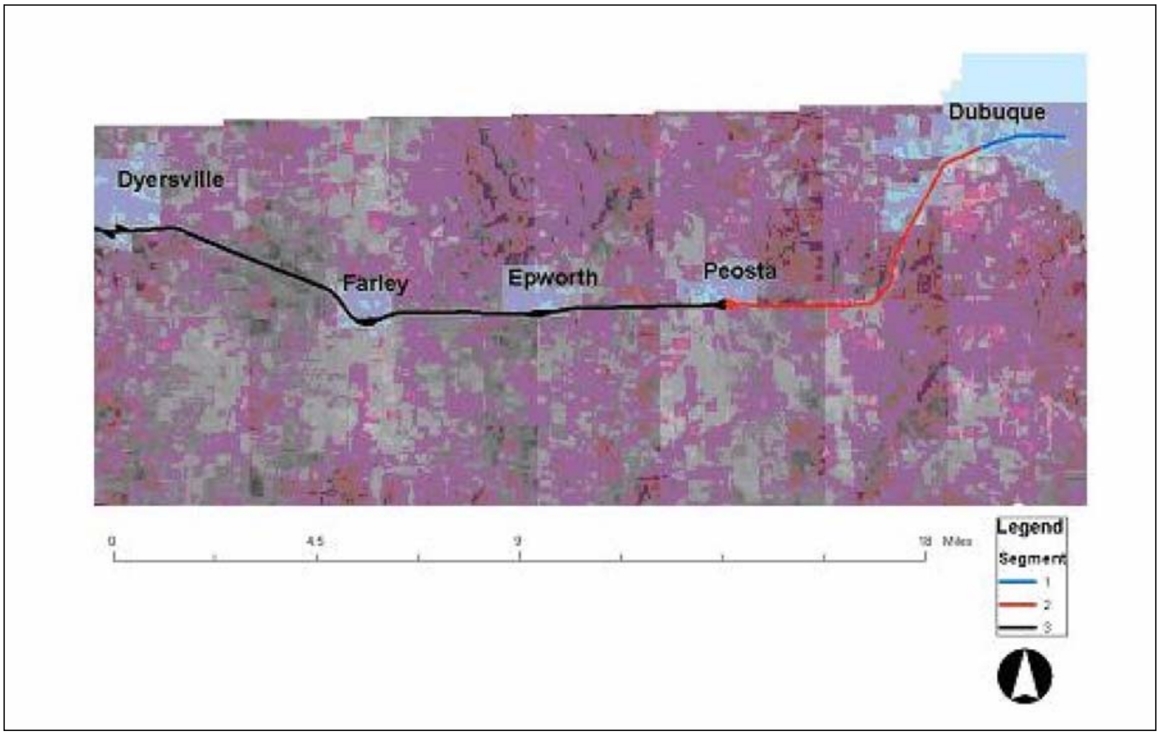
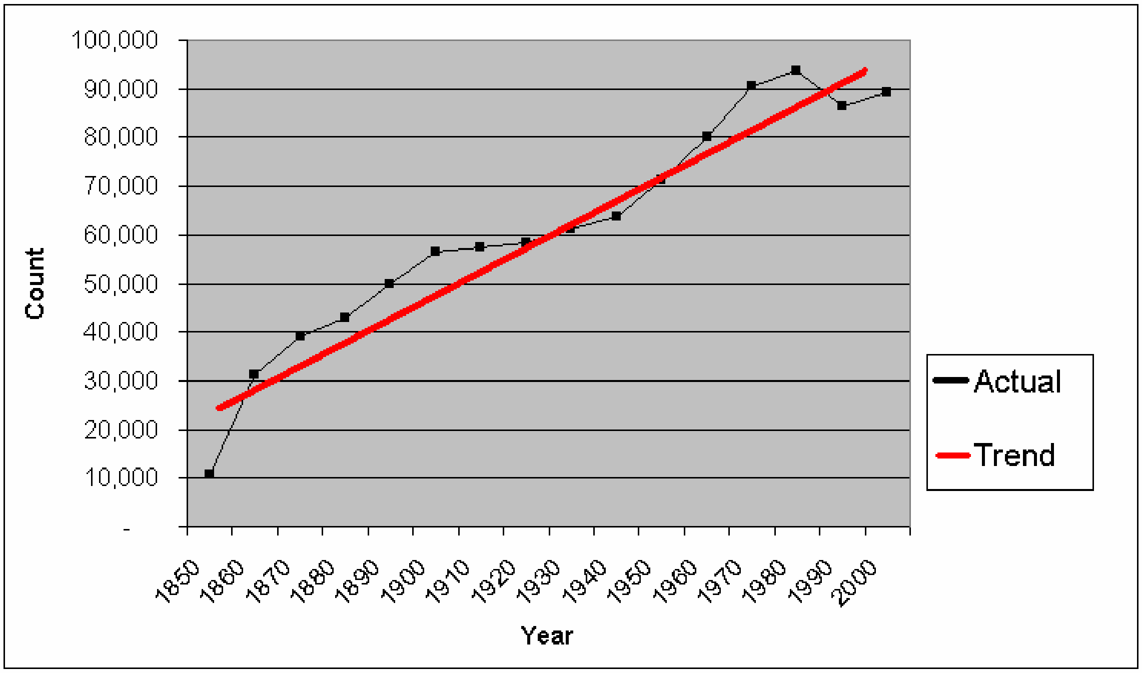


Figure A.1. U.S. 20 study area

Population

The population of Dubuque County has been following a gradual upward trend for decades. Since the first recorded U.S. Census, the population continued to increase, reaching a high of 93,745 in 1980. As shown in Figure A.2, the County's population began to increase significantly in 1950. More recently, in 1990 there was a slight decrease to 86,403 persons, which is currently on the rebound, totaling 89,143 persons in 2000, an increase in population of 3.2 percent from 1990 to 2000. According to the

Office of Social and Economic Trend Analysis, Iowa State University, an estimate for the 2002 population (based on U.S. Census Bureau) is approximately 89,387 persons.



Source: U.S. Census Bureau

Figure A.2. Dubuque county population, 1850-2000

While the population of the county is on the rise, many of the cities are experiencing increases in population. Like county trends, the cities of Dubuque, Dyersville, and Epworth experienced declines in population from 1980 to 1990. However, the populations of these cities did increase from 1990 to 2000 (as shown in Table A.1). The City of Peosta experienced the largest increase in population; from 1980 to 1990 the city increased by 6.7% and from 1990 to 2000 the population increased by 523 persons, which is an increase of 408.6%. The only city that experienced a decrease in population was Farley. The population of Farley increased by 5.2% from 1980 to 1990, but decreased by 1.48% from 1990 to 2000 to a total of 1,334 persons.

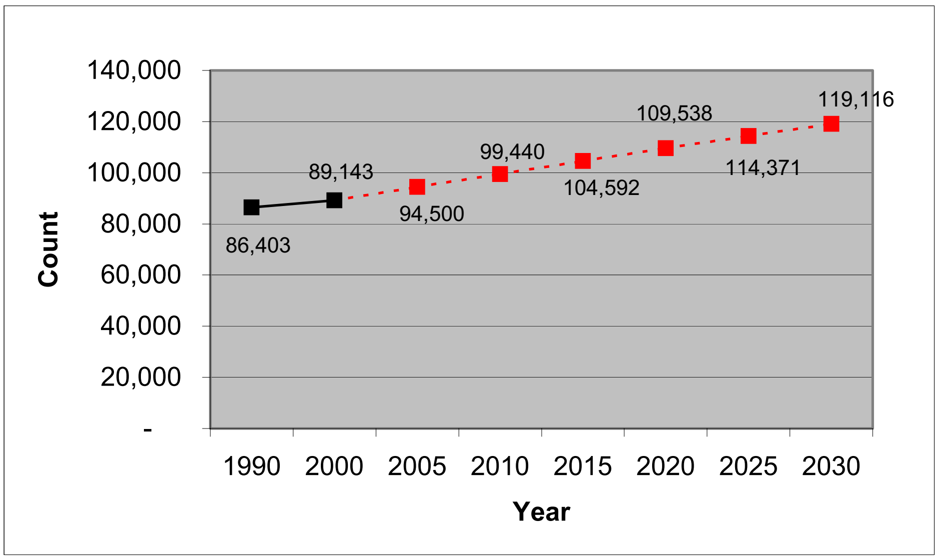
Table A.1. Change in population by city

City	1980	1990	2000	% Change 1980-1990	% Change 1990-2000
Dubuque	62,321	57,546	57,686	-7.66	0.24
Dyersville	3,825	3,703	4,035	-3.19	8.97
Epworth	1,380	1,297	1,428	-6.01	10.1
Farley	1,287	1,354	1,334	5.21	-1.48
Peosta	120	128	651	6.67	408.59

Source: Office of Social and Economic Trend Analysis, Iowa State University

County Projections

According to projections provided by East Central Intergovernmental Association (ECIA), the county population is expected to increase at a steady rate. The population is projected to increase to 94,203 persons in 2005, an increase of 5.7% from 2000. From 2005 to 2010, the population is projected to increase to 99,440, a total increase of 5,237 persons, or 5.6%. From 2010 to 2015, Dubuque County is expected to increase by 5,152 persons 104,592 persons, an increase of 5.2%. From 2015 to 2020, the county's population is projected to increase by 4,946, an increase of 4.7%, which would total around 109,538 persons. The county's population is projected to increase by 4,833 persons from 2020 to 2025, an increase of 4.4%. From 2025 to 2030, the county's population is projected to increase from 114,371 persons to 119,116 persons, an increase of nearly 33,000 persons from 1990 to 2030.



Source: East Central Intergovernmental Association

Figure A.3. Dubuque county population projections

Table A.2 shows population projections for Dubuque County and the City of Dubuque. The City of Dubuque currently comprises 64.7% of the population in Dubuque County. The populations of both the county and the City of Dubuque are projected to increase. As the projections in Table A.2 show, the county is expected to reach a high of 49,310 persons by 2030 and the City of Dubuque is expected to increase to a high of 69,806 persons by 2030. According to the projections, from 2000 to 2030, the population is expected to increase by 56.8% and the City of Dubuque is expected to increase by 21.0%. The table shows that the rural portion of the county and small cities in the county are expected to grow at a faster rate.

Table A.2. Country and city population projections

Projection	2000	2005	2010	2015	2020	2025	2030	% Change 2000-2030
County	31,457	34,407	37,488	40,534	43,478	46,394	49,310	56.75%
City of Dubuque	57,686	59,796	61,952	64,058	66,060	67,977	69,806	21.01%

Source: East Central Intergovernmental Association

As Table A.3 indicates, the number of commuters into Dubuque County has increased since 1990. According to the 1990 U.S. Census, 7,896 persons commuted into the county for work, which made up 17% of the total workers in the county. For 2000, approximately 19% of the total workers in Dubuque County commuted into the county with nearly 10,000 persons commuting into the county. The majority of these commuters' origins are Grant County (Wisconsin), Jo Daviess County (Illinois), Jackson and Delaware County (Iowa). Approximately 1,100 of the commuters are from Delaware County to the west of Dubuque County.

Table A.3. Dubuque county commuting

	1990	2000
Total workers in Dubuque County	47,535	52,331
Live and work in Dubuque Co.	39,639	42,387
Live elsewhere and work in Dubuque Co.	7,896	9,944
% workforce commuting in	17%	19%
Live in Dubuque Co. and work elsewhere	1,945	2,780
% resident workers commuting out	5%	6%

Source: U.S. Census Bureau

Current Land Use

The U.S. 20 corridor from Dyersville to Devon Drive has been divided into three segments for this study. The first segment extends through the urban setting of the City of Dubuque, from Devon Drive to Northwest Arterial. Segment Two spans approximately 7.5 miles from Northwest Arterial in the City of Dubuque to Peosta. This segment is a transition from the urban setting of Dubuque to the rural county. Segment Three extends 15 miles in the rural setting of Dubuque County, which passes by the cities of Peosta, Epworth, Farley, and Dyersville.

Segment One

Segment One is lined with commercial land uses to the north and the south of U.S. 20. There is approximately a two-mile stretch of commercial use along Segment One, which is exposed to heavy traffic into and out of the City of Dubuque. The commercial use from the City of Dubuque has a large impact on the rural communities along U.S. 20. Residential use encompasses the area along Segment One, but is not directly accessed from U.S. 20. Of the segments along the corridor study, Segment One has the highest average annual daily traffic (AADT) (over 24,000) due to the mixed land use (primarily commercial) in the City of Dubuque. See Figure A.4 for a map of the current land use along Segment One.

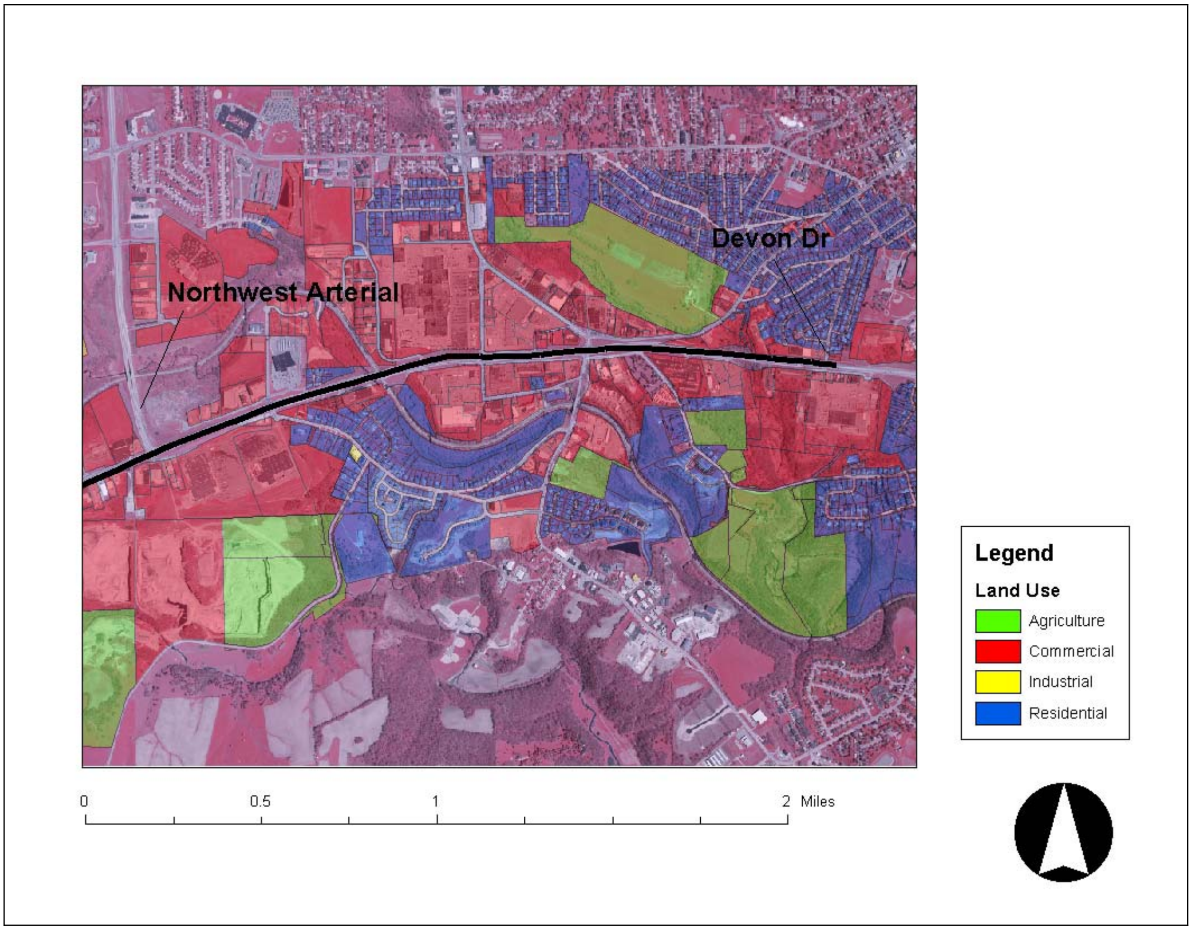


Figure A.4. Current land use, Segment One

Figure A.5 shows two parcels that the Iowa Department of Transportation (Iowa DOT) owns in order to preserve future alignment options along the U.S. 20 corridor. As shown in the figure, there is one parcel east of the study area boundary at Devon Drive. The other Iowa DOT owned parcel along Segment One is located to the east of Northwest Arterial. This particular parcel does not have direct access from U.S. 20 or Northwest Arterial. Currently it can only be accessed from a frontage road from U.S. 20.

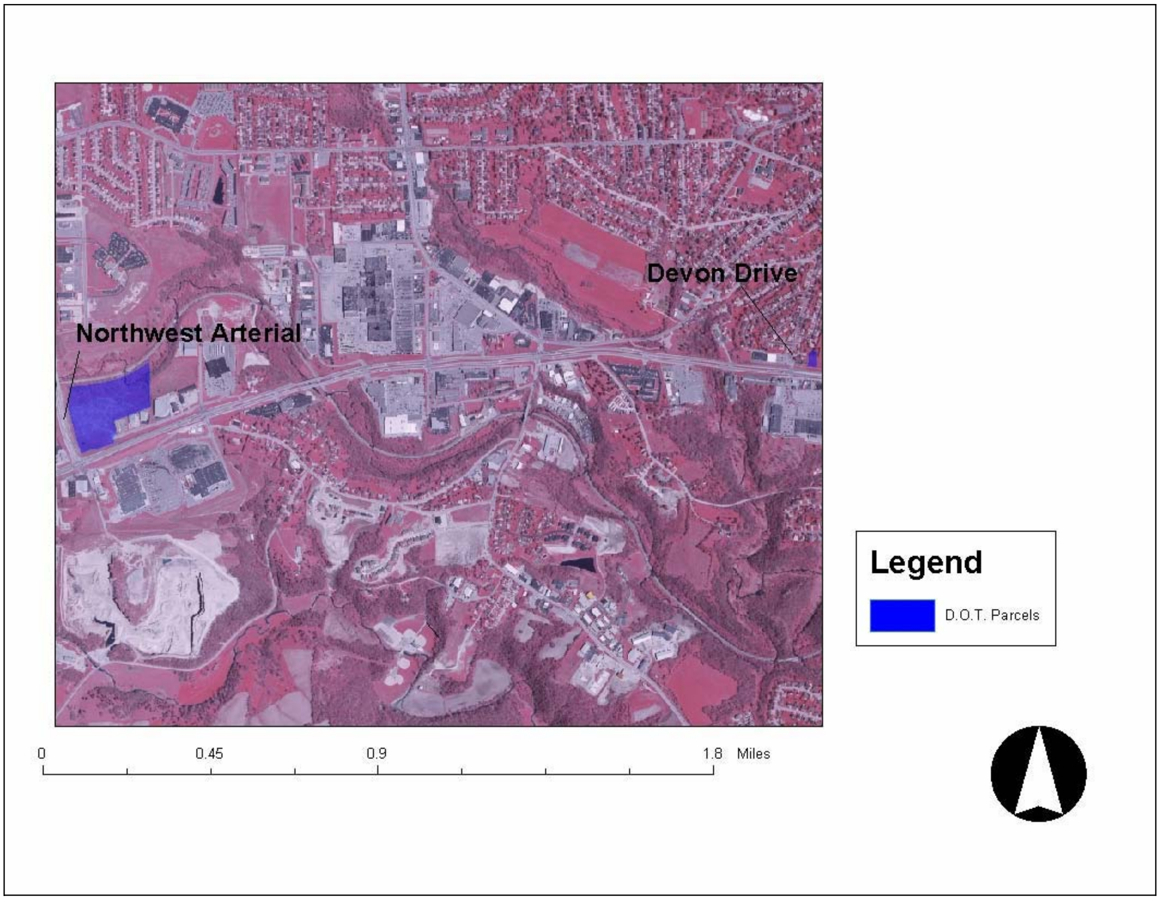


Figure A.5. Iowa DOT owned parcels, Segment One

Segment Two

Segment Two spans approximately 7.5 miles from Northwest Arterial to the city limits of Peosta. This segment of U.S. 20 is the suburban segment of this study, and it is a transitional corridor between the urban environment of the City of Dubuque and rural portions of the county. The land use changes from primarily commercial to agricultural use in this 7.5 mile stretch. Commercial use extends approximately four miles from Northwest Arterial to Swiss Valley Road, located outside the city limits of Dubuque, to the southwest. This commercial land use is slowly expanding to the west where there is an abundance of agricultural use. In addition, residential use is located to the east of the commercial use along this strip to Swiss Valley Road. However, there is not direct access to the southeast residential parcels from U.S. 20. There are primarily agricultural land uses to the west of this segment from Swiss Valley Road to Peosta. See Figure A.6 for a map of the current land use for Segment Two.

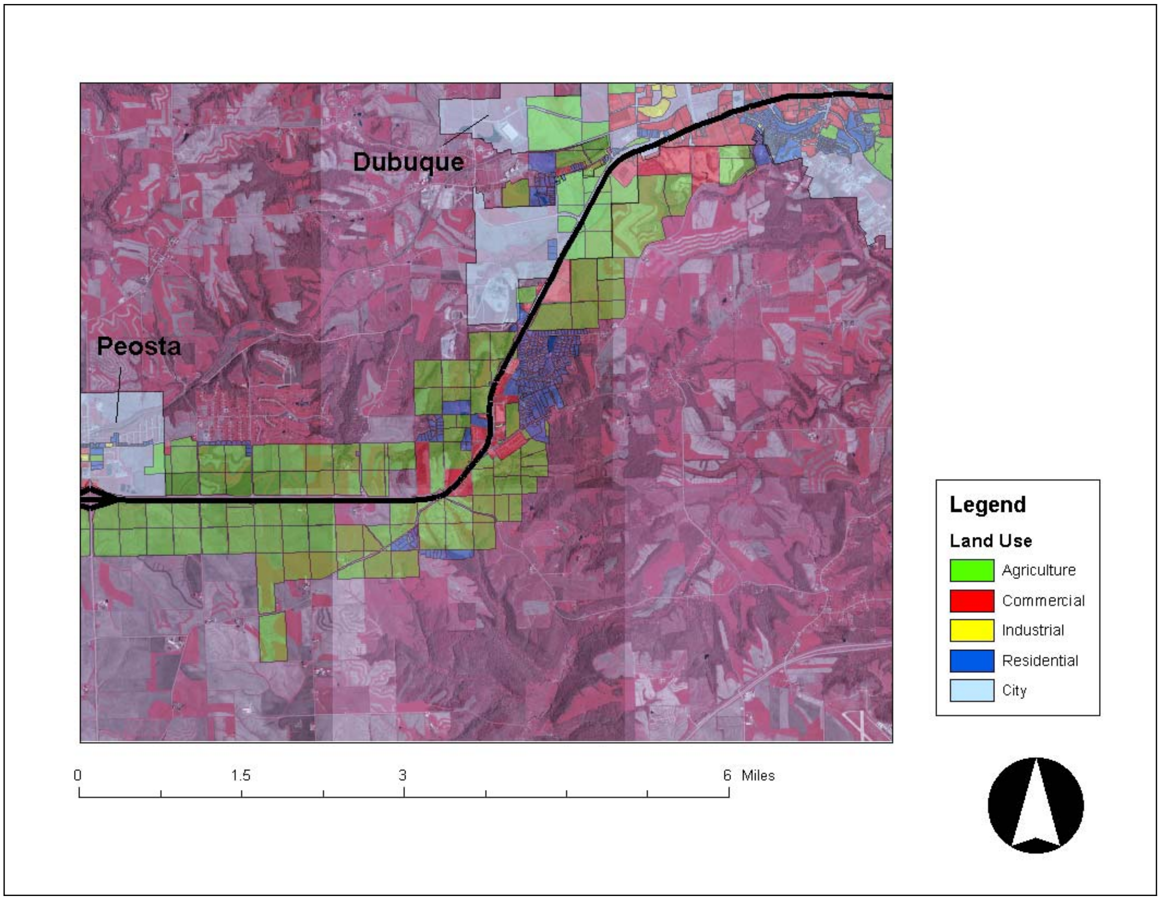


Figure A.6. Current land use, Segment Two

There are numerous parcels owned by the Iowa DOT along Segment Two. These parcels were obtained by the DOT in order to preserve the corridor from further development, which would pose problems should a decision be made to rebuild this facility as a freeway. See Figure A.7 below for a map of these parcel locations.

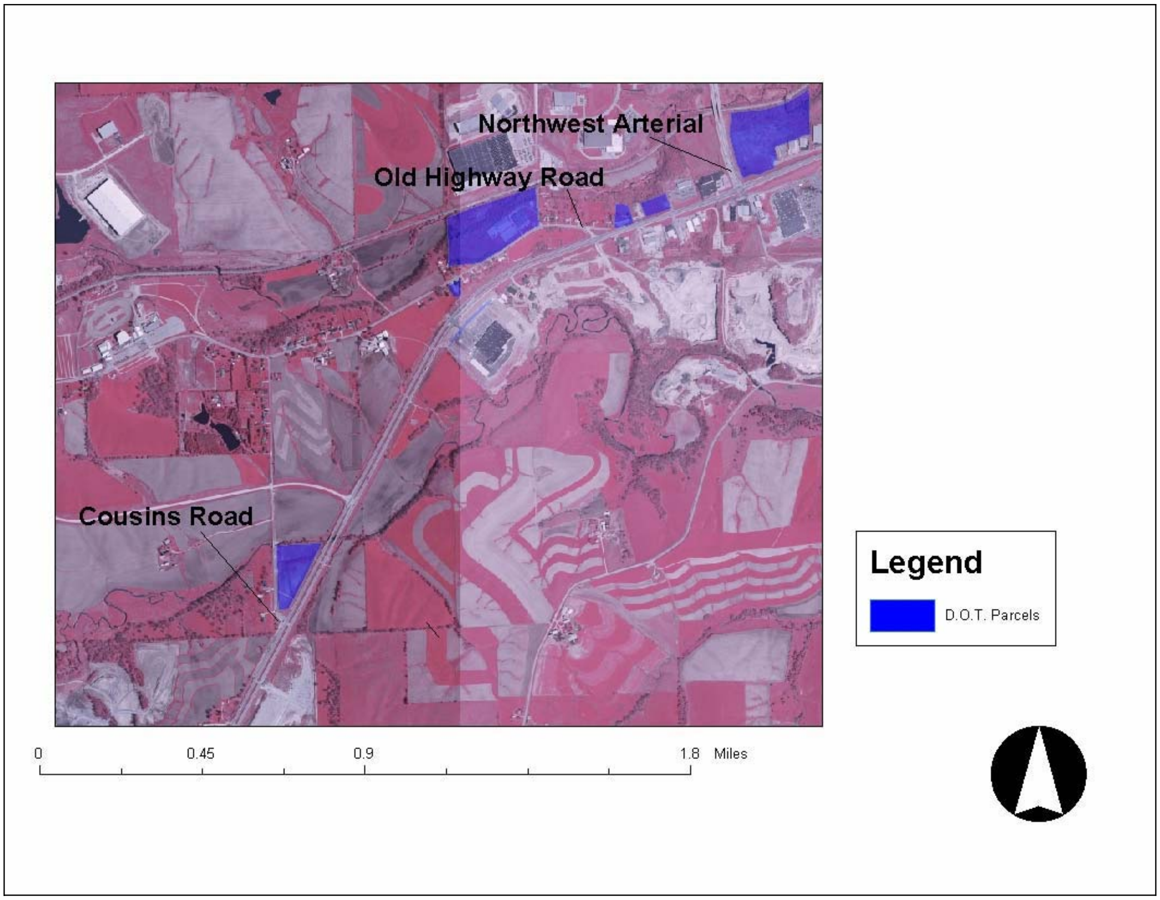


Figure A.7. Iowa DOT owned parcels, Segment Two

Segment Three

Segment Three is approximately 15 miles long and consists primarily of agricultural use, except within city limits (Epworth, Farley, and Dyersville). There is little commercial or residential activity along this rural segment. Segment Three runs through the urban areas of Peosta, Epworth, Farley, and Dyersville. There is little commercial land use where U.S. 20 crosses the City of Peosta. Most of the residential use is in the northern and western portions of Peosta. Located in the western half of Peosta, there is approximately a one-mile strip of industrial use to the north of U.S. 20. Agricultural use dominates from Epworth to Farley along Segment Three. However, there is approximately a one-mile strip of land, which is primarily residential with some commercial use located just east of the Dyersville city limits. See Figure A.8 for a map of the current land use for Segment Three.

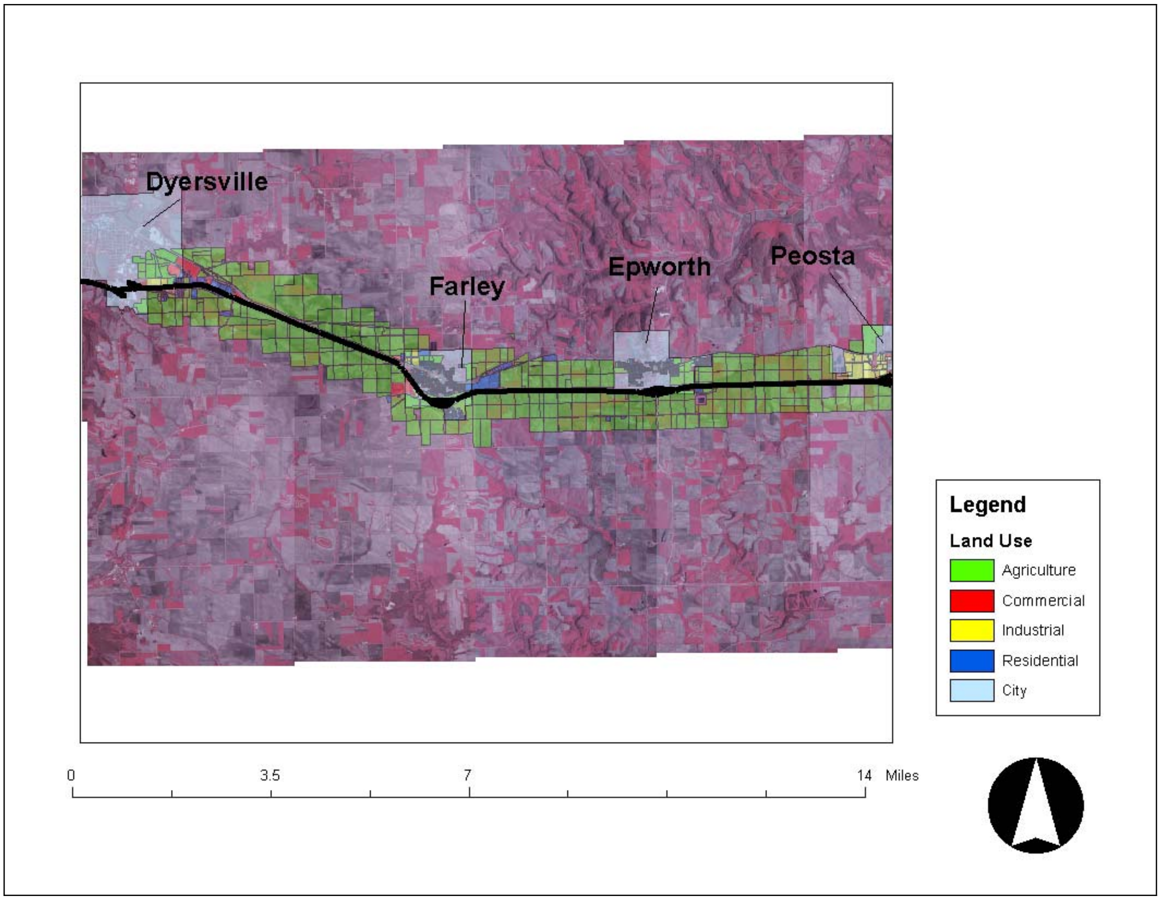


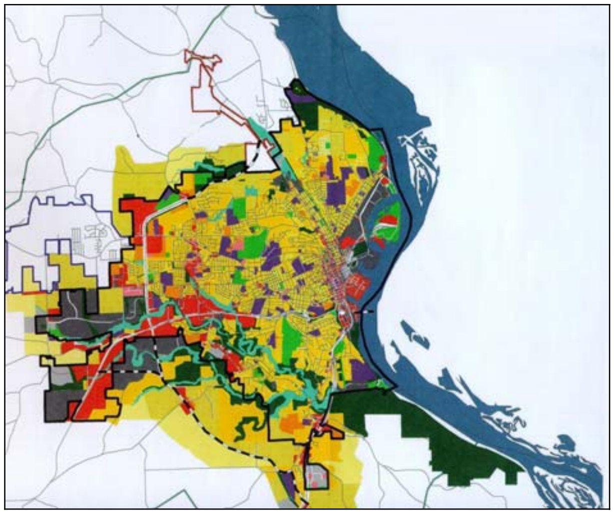
Figure A.8. Current land use, Segment Three

Future Land Use

Segment One

The future land use map for Segment One does not indicate any major changes from the current land use pattern. From Devon Drive to Century Drive, the current land use is designated for commercial use. According to the 1997 Dubuque County Comprehensive Plan, there is land designated for industrial use south of U.S. 20 off of Cedar Cross Road. North of U.S. 20, to the west of Oak Grove Drive, there is land designated for multi-family residential use. Multi-family residential use is also designated to the north of U.S. 20 along Northwest Arterial.

The Proposed Land Use Map for the City of Dubuque (Figure A.9), adopted on November 18, 2002, shows a strip allowing for commercial growth west of Northwest Arterial. This proposed commercial use transitions into segment two of the corridor to the city limits of Dubuque. Additional commercial use along this portion of the corridor could raise future concerns about access, accidents, and congestion.

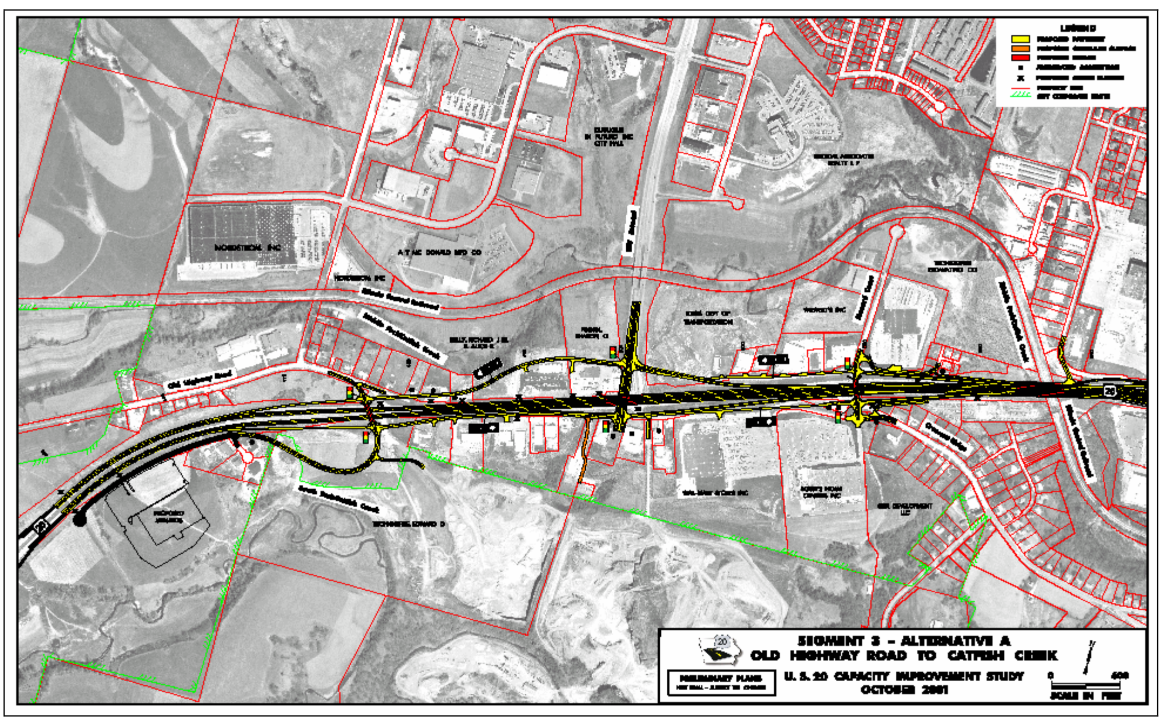


Source: Proposed Land Use Map, City of Dubuque 11/02

Figure A.9. Future land use, Segment One

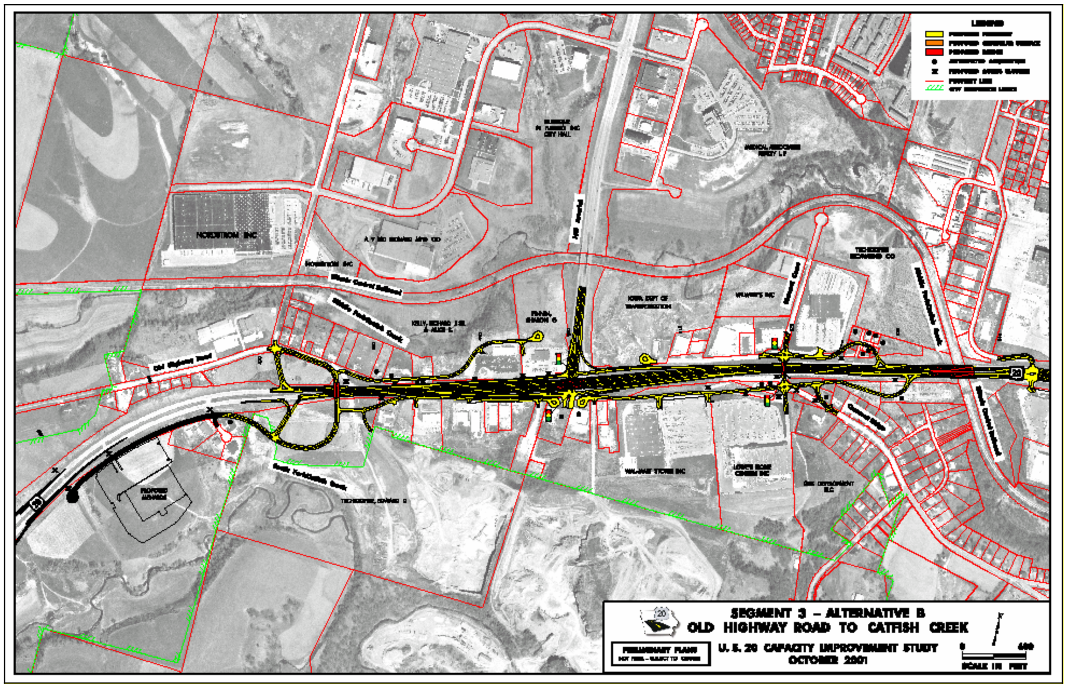
Proposed Interchanges: Segment One

There are currently several different proposed interchanges along U.S. 20. The proposed interchanges are indicated in HDR Inc's corridor planning study conducted in 2002. Figures A.10, A.11, and A.12 show some alternatives from Old Highway Road to Catfish Creek. It is suggested that future commercial uses be concentrated near these potential locations for interchanges.



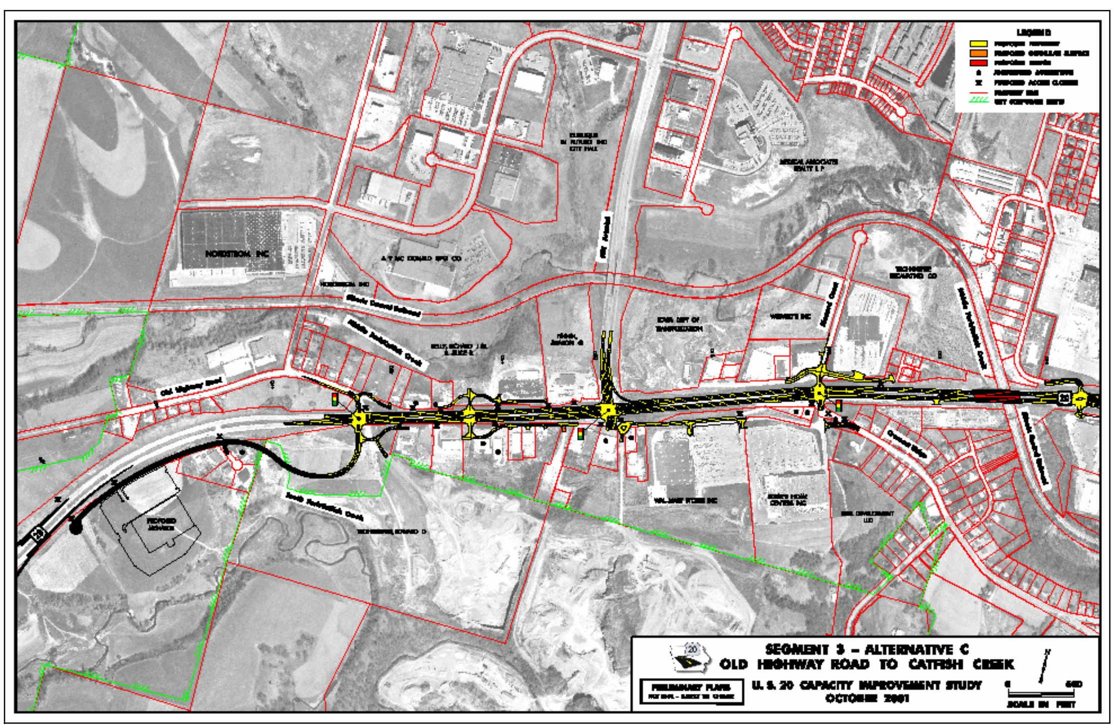
Source: HDR Inc.

Figure A.10. Proposed interchange: alternative A, from Old Highway Road to Catfish Creek



Source: HDR Inc.

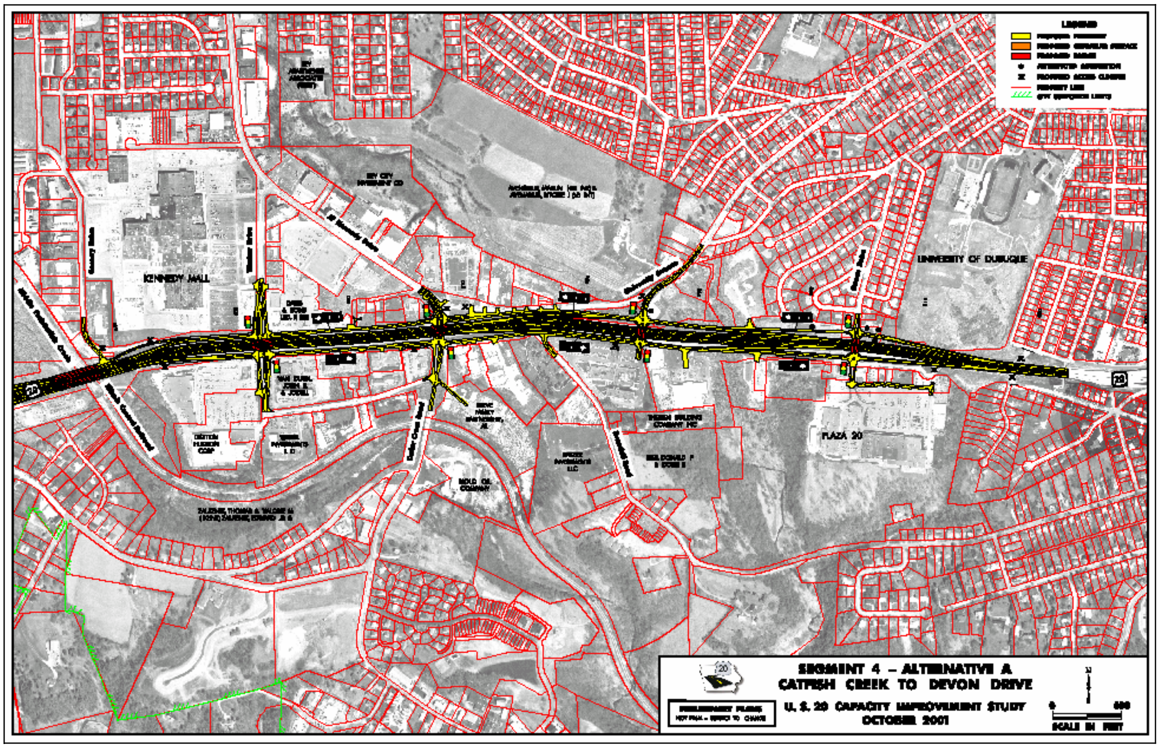
Figure A.11. Proposed interchange: alternative B, from Old Highway Road to Catfish Creek



Source: HDR Inc.

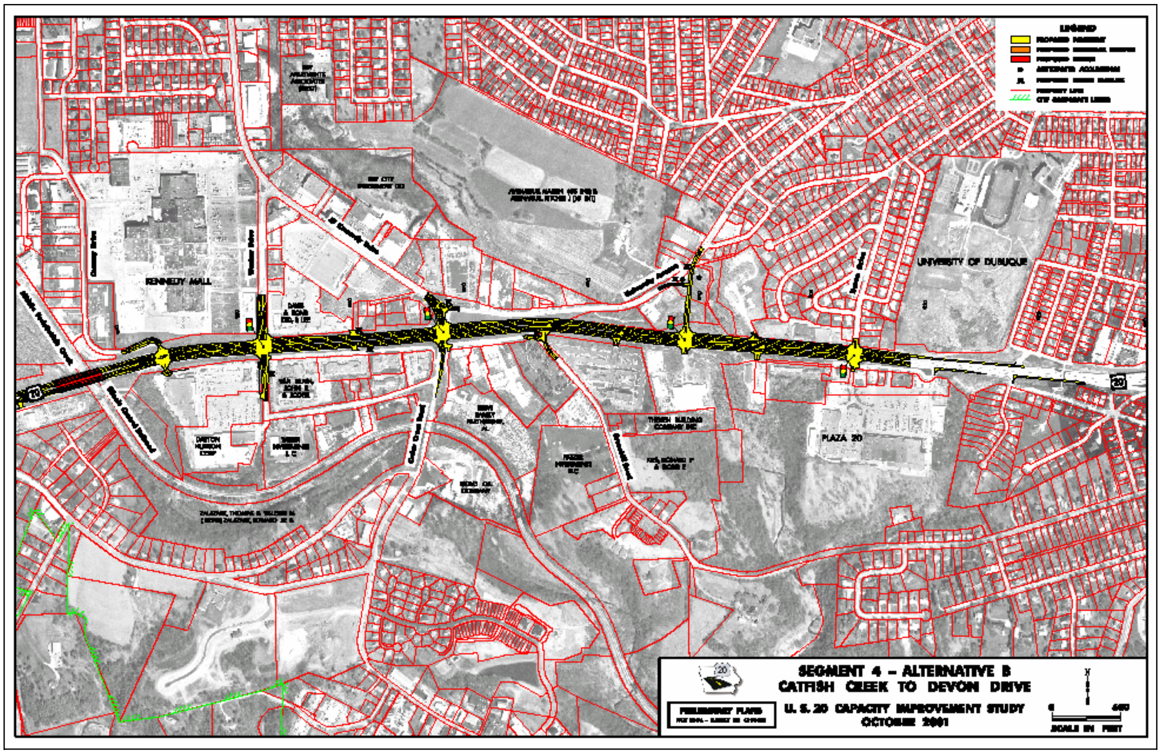
Figure A.12. Proposed interchange: alternative C, from Old Highway Road to Catfish Creek

Figures A.13 and A.14 show other locations along Segment One for potential access locations. Alternative A indicates bridges along U.S. 20 separating turning traffic from through traffic, thus eliminating numerous access locations. Alternative B does not require bridges; however, it does indicate access locations that could be consolidated. All of these alternatives are proposed by HDR Inc., and they should be considered in order to determine locations for future development.



Source: HDR Inc.

Figure A.13. Alternative A, Catfish Creek to Devon Drive



Source: HDR Inc.

Figure A.14. Alternative B, Catfish Creek to Devon Drive

Segment Two

The future land use pattern along Segment Two should not change significantly from the current land use. There is industrial use in the future land use plans. There are four locations, which are identified for future industrial use to the north and south of U.S. 20, located right outside the city limits of Dubuque. Increasing industrial use would have some impact on traffic on U.S. 20, although not as much as commercial uses.

There is currently commercial land use along Segment Two near Swiss Valley Road. The future land use map indicates room for some commercial growth in that area. The future land for this segment indicates that much of the current agricultural land is designated for rural residential development. The map indicates that almost a mile east of the city limits of Peosta, there is room for commercial use. This site is north of U.S. 20 and stretches 0.43 miles.

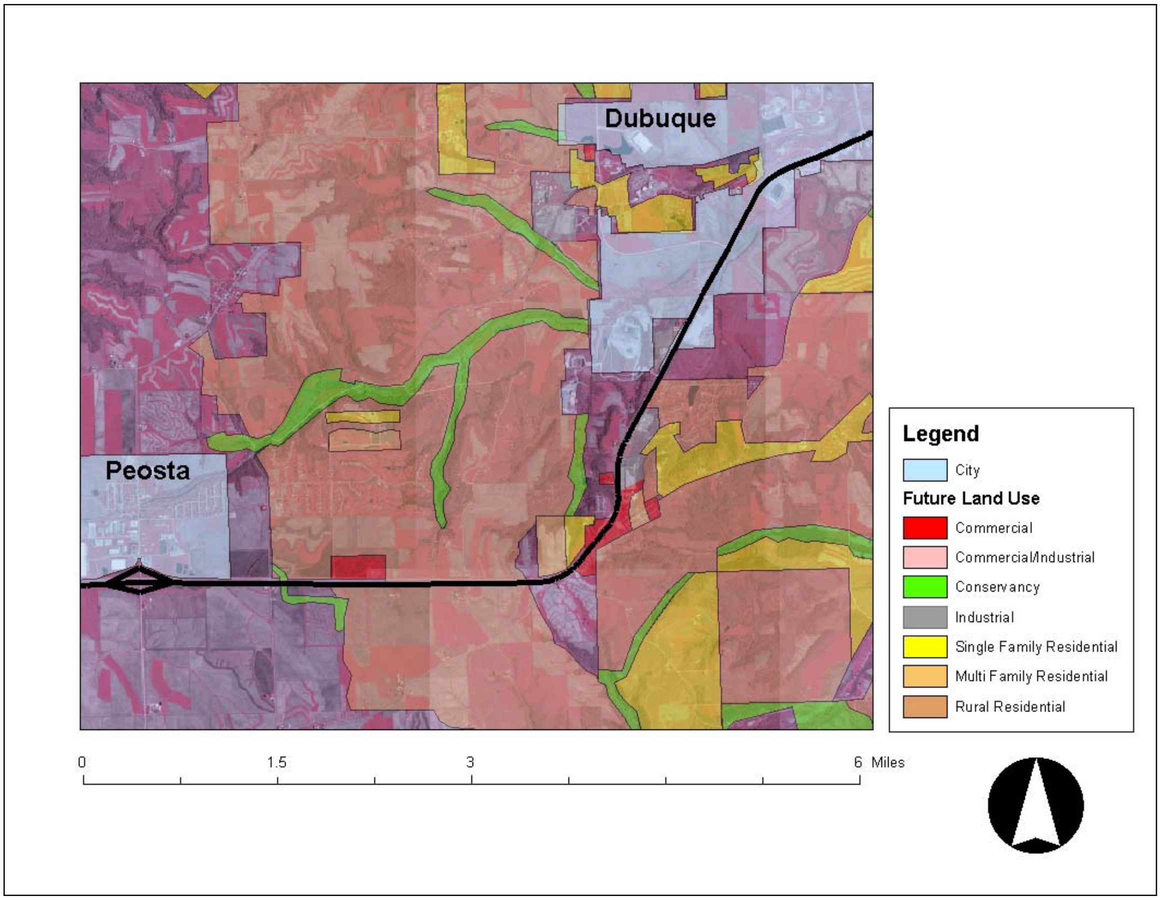
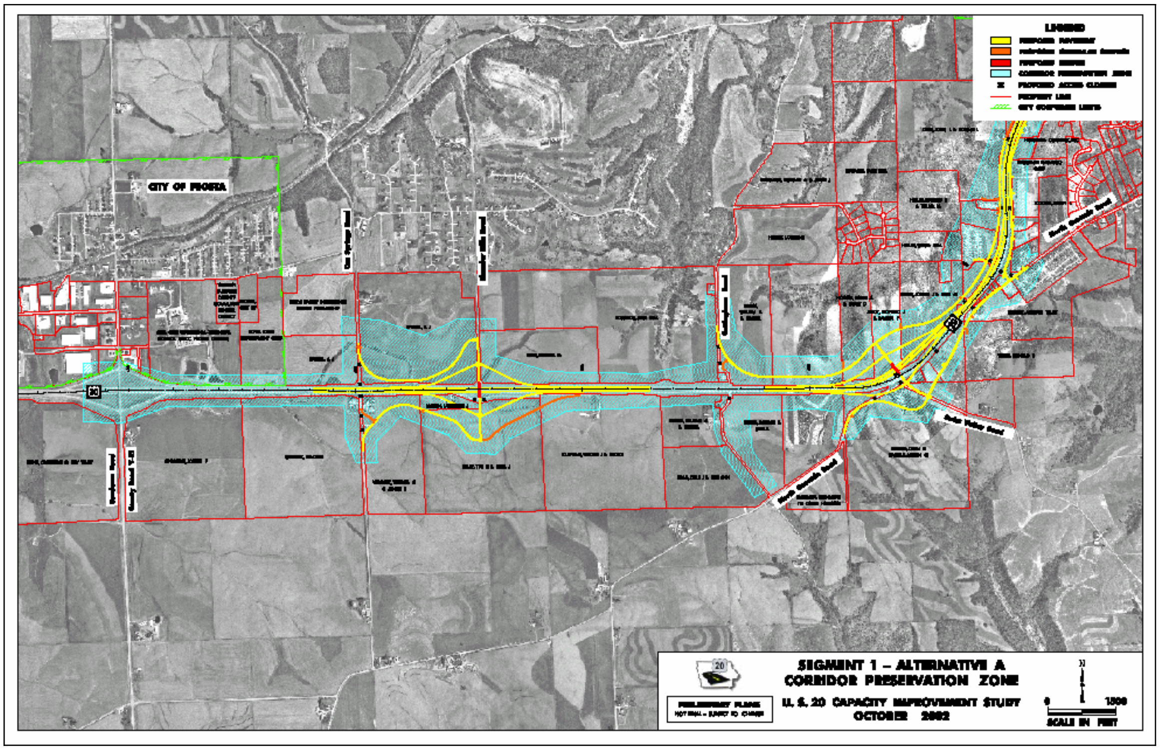


Figure A.15. Future land use, Segment Two

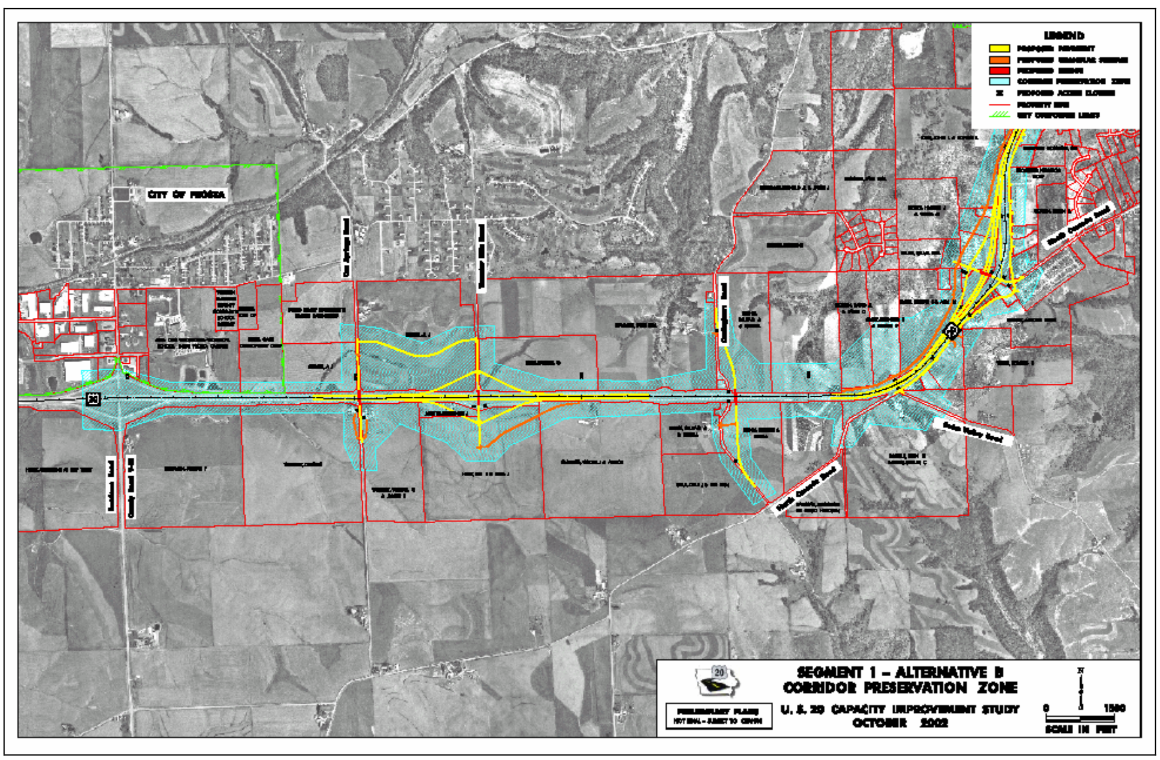
Proposed Interchanges: Segment Two

As shown in Figures A.16 and A.17, HDR has proposed interchanges at either Swiss Valley Road or North Cascade Road. It is suggested that future commercial land use be concentrated around these interchanges. Alternative A would provide access to Swiss Valley Road, North Cascade Road, and Cottingham Road. Alternative B would provide direct access to Swiss Valley Road and North Cascade Road. These interchanges would prove beneficial to U.S. 20 by allowing higher average speeds, thus providing a better level of service and potentially reducing the amount of access-related crashes.



Source: HDR Inc.

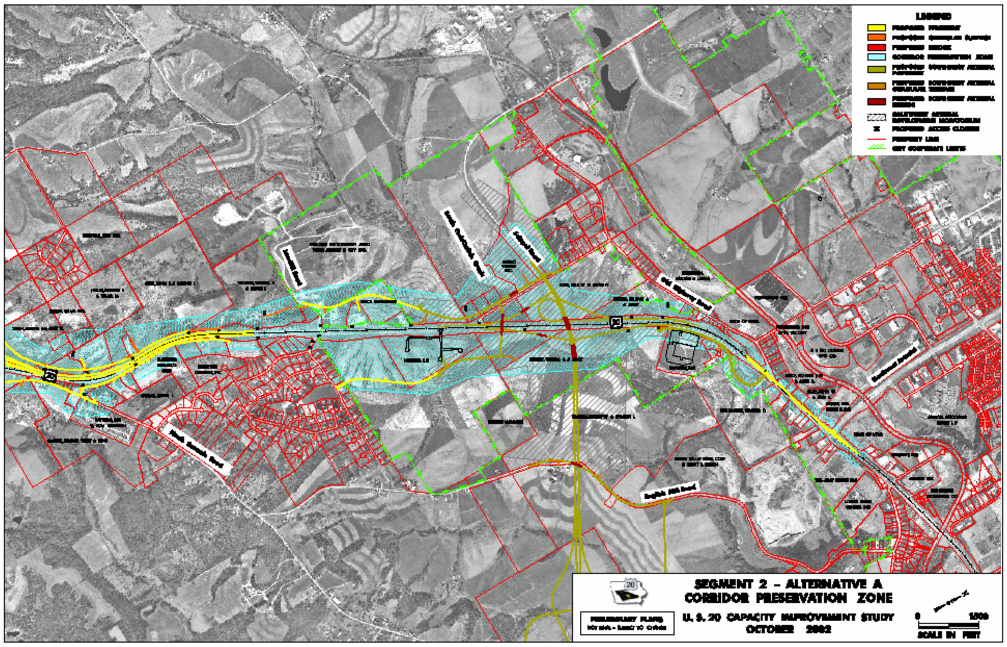
Figure A.16. Proposed interchange, Swiss Valley Road



Source: HDR Inc.

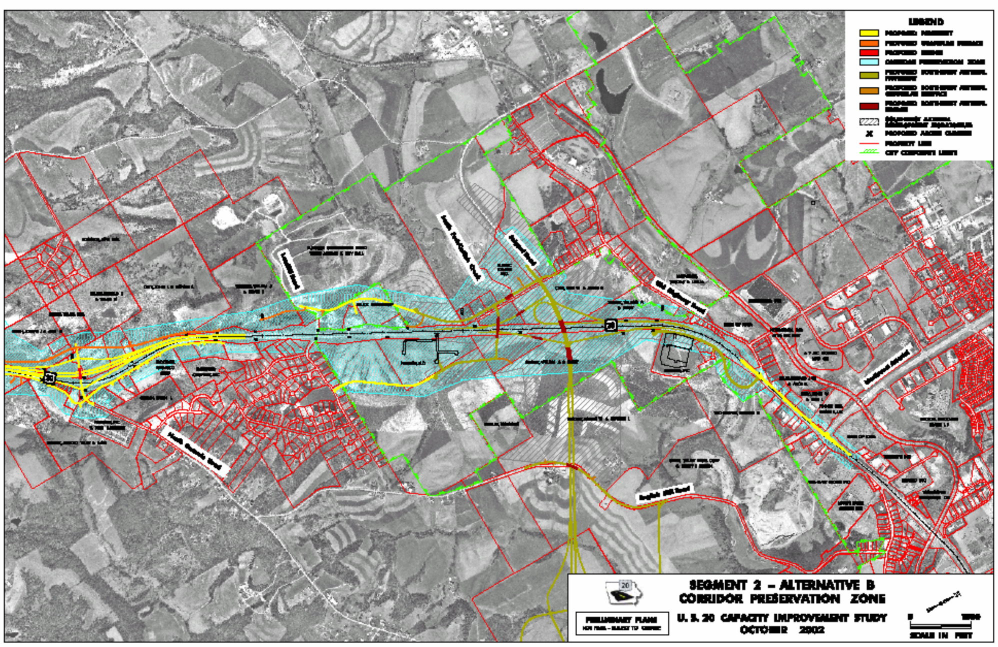
Figure A.17. Proposed interchange, North Cascade Road

The HDR study also indicates alternatives for interchanges at North Cascade Road, which are shown in Figures A.18 and A.19. Both interchanges would provide access to North Cascade Road, where commercial use should be concentrated in the future.



Source: HDR Inc.

Figure A.18. Possible interchange: alternative A, at North Cascade Road



Source: HDR Inc.

Figure A.19. Possible interchange: alternative B, at North Cascade Road

Segment Three

The future land use map for Segment Three indicates little change from current land use. From Peosta to Epworth, there is no indication of land use changes. The area to the south of U.S. 20 and west of Farley is designated for future commercial and industrial use. Located south of the Farley city limits and to west of North Pleasant Grove Drive, there is a 0.44 mile strip of land along U.S. 20, designated for commercial use; currently, this parcel is zoned for agricultural use. West of Farley, there is an abundance of land designated for commercial or industrial use. This land is currently zoned for agricultural and some commercial use. See Figure A.20 below.

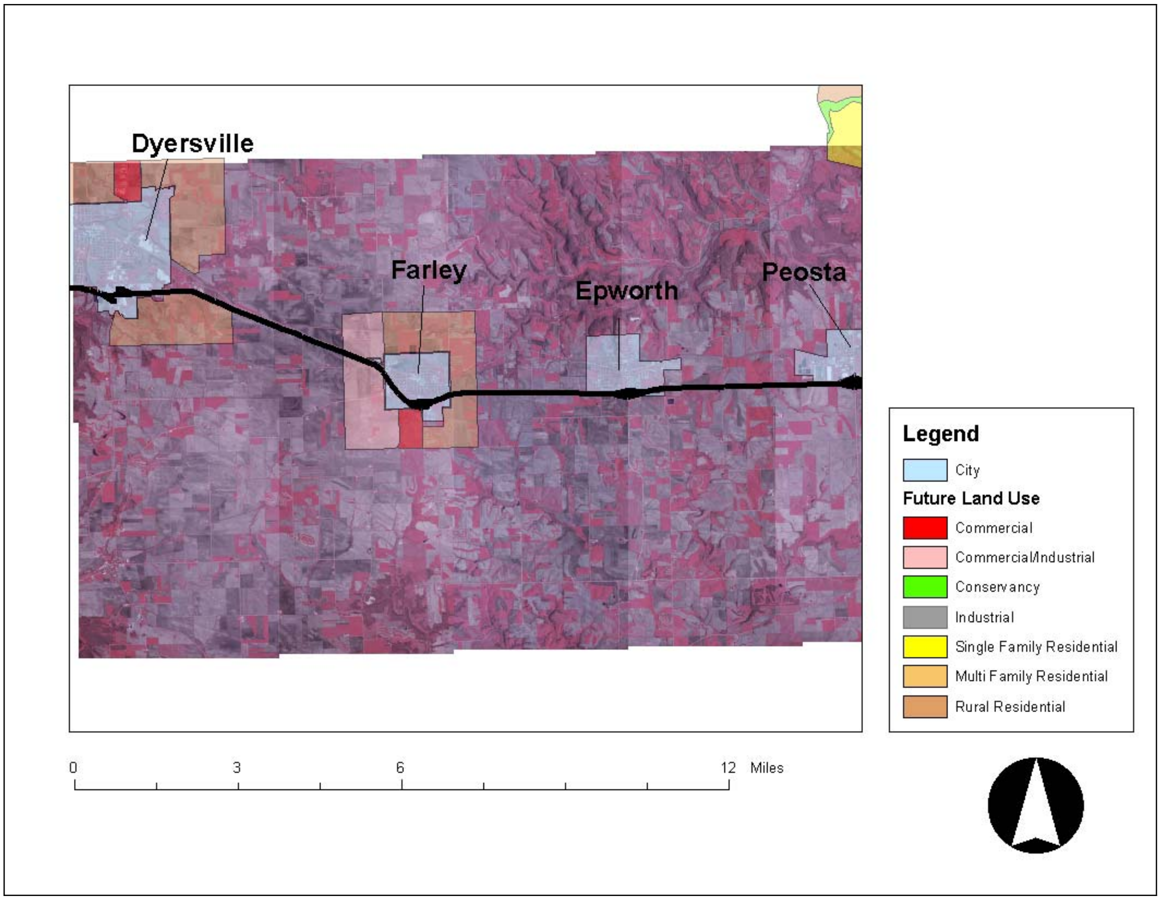


Figure A.20. Future land use, Segment Three

The land use along the study area can best be summarized as:

- Segment One
  - Current Land Use
    - Predominantly Commercial
    - Essentially built-out, with little potential for further development
  - Future Land Use
    - Continue to exist as a commercial strip, with some changes in individual parcels and businesses

- Segment Two
    - Current Land Use
        - Mix of commercial, industrial, and agricultural use
        - Considerable potential for new development
    - Future Land Use
        - Some potential for land development
        - Continue to develop as a commercial and industrial strip (eastern portion of Segment Two)
        - Large lot residential (eastern portion of Segment Two)
- Segment Three
    - Current Land Use
        - Predominantly agriculture with the exception of cities and the area around them
        - Potential for development only at the edge of cities
    - Future Land Use
        - Will remain largely agricultural, with exception of area in and around Peosta, Epworth, Farley, and Dyersville

Driveway Density

Driveway density indicates how many driveways are located along the corridor per mile. It is an indicator of potential access-related problems, including right-turn, left-turn, and rear-end collisions. The driveway density was calculated for all three segments of the corridor. The driveway densities for Segment One and Segment Two are much higher than for Segment Three. Segment One has the highest density because it is within the city limits of Dubuque where there is an abundance of commercial land use. Segment Two is within the city limits of Dubuque (approximately 2.54 miles in the city) but also extends into the county. The future land use plans indicate that the land adjacent to U.S. 20 in the city limits is indicated for commercial growth. Increased commercial growth would likely result in additional driveways along this portion of U.S. 20.

Table A.4. Driveway density per segment

	Driveway Count	Segment Length	Driveway Density Per Mile	Qualitative Assessment
Segment One	9	2.00 mi.	4.50	Moderate
Segment Two	30	7.50 mi.	4.00	Moderate
Segment Three	5	14.91 mi.	0.34	Very Low

There are a total of nine driveways along the two-mile strip of Segment One. The driveway density for Segment One is 4.5, which means that there are approximately 4.5 driveways per mile along this segment. One would assume that the driveway density would be much higher along Segment One due to the commercial use in the City of Dubuque compared to the suburban and rural portions of the corridor. However, in the case of US 20, Segment One driveways are moderately well controlled, and there are few chances for new driveways. On the other hand, Segment Two had a moderate driveway density and considerable land that could be developed—a potentially bad combination. A corridor with a driveway density of 4.5 per mile indicates that the chance of a collision is greater than one with no driveways due to the numerous conflict points that are a result of the driveways. As shown later in this report, the total crash rates and access related crash rates are higher along Segment One compared to the other segments. Figure A.21 shows driveway locations along Segment One.

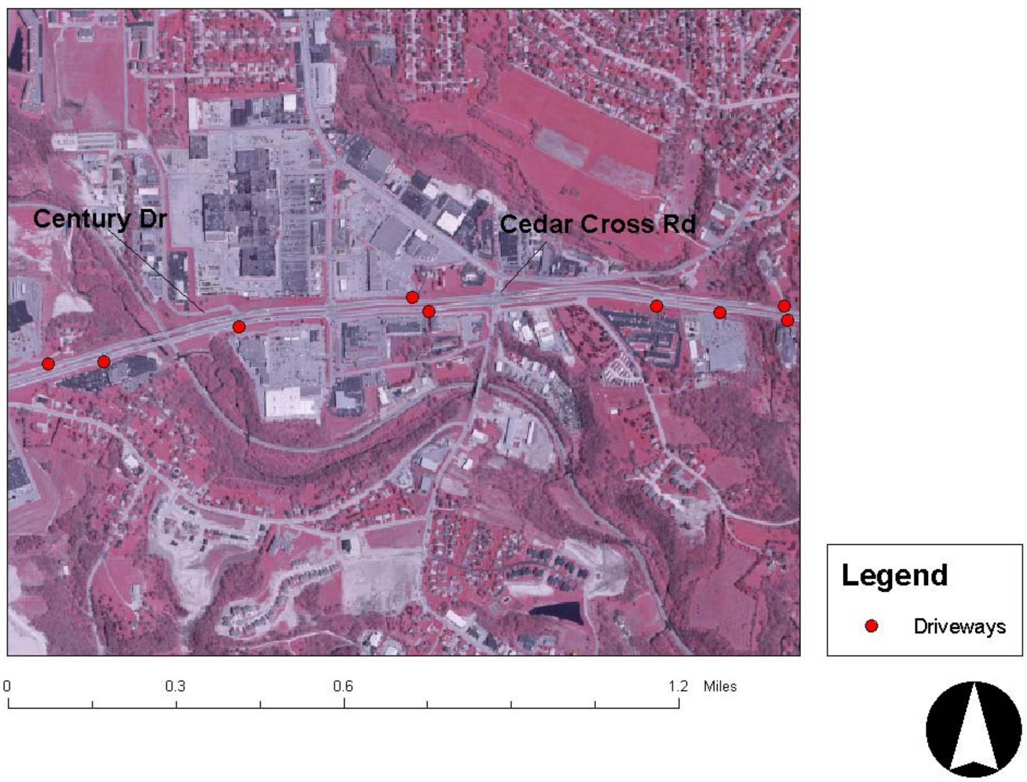


Figure A.21. Driveway locations, Segment One

Thirty driveways were identified along Segment Two of the study area. The segment length is 7.50 miles long, with a driveway density of 4.00 driveways per mile. The driveway density is currently not a pressing issue along Segment Two; however, if additional development occurs, the number of driveways would increase, which increases the chances of an access-related crash to occur. Ideally, an urban arterial roadway should not exceed ten driveways per mile, or it is more susceptible to accidents. A rural arterial should have a driveway density of eight driveways per mile or less since traffic speeds are higher and the possibility of serious collisions exists at any driveway.

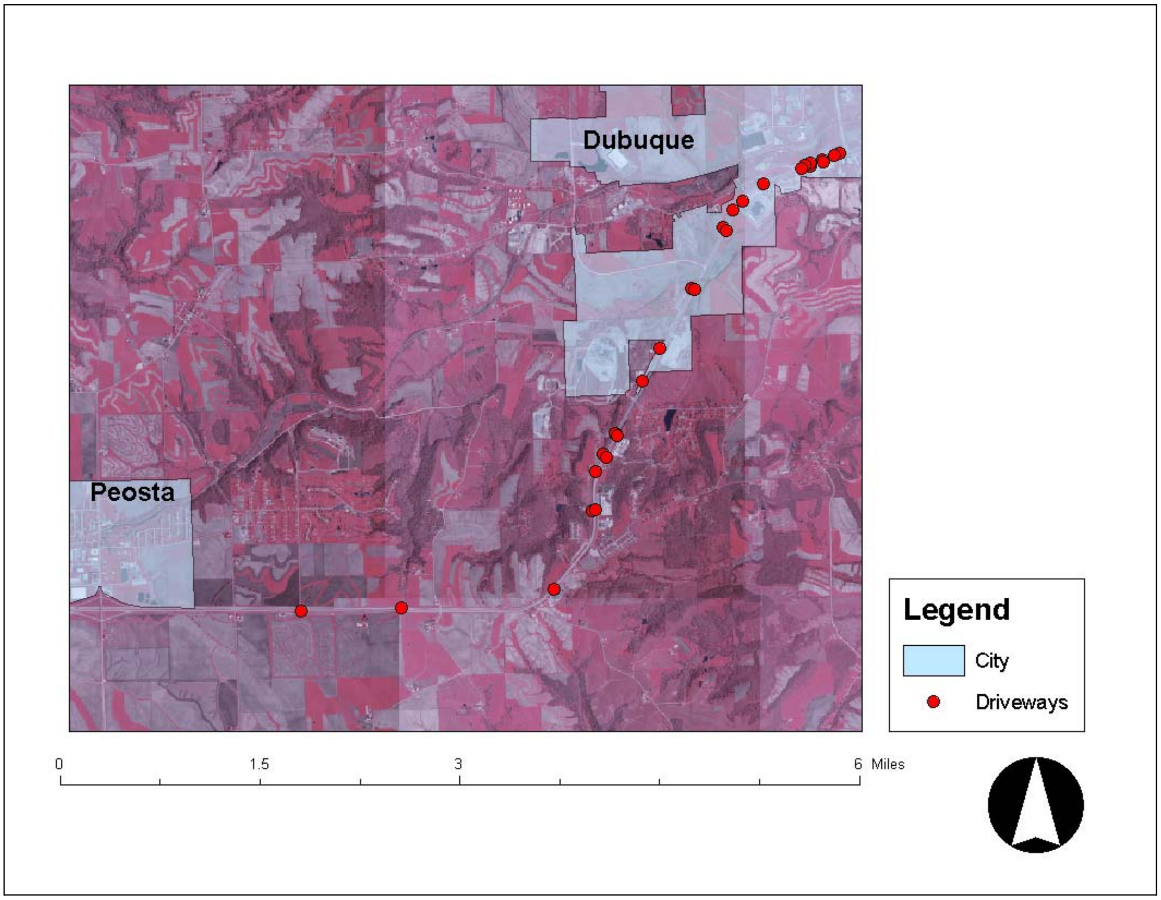


Figure A.22. Driveway locations, Segment Two

As expected, Segment Three, being the most rural segment, has the least amount of driveways, with only five along the 14.91-mile segment. The driveway density for Segment Three is therefore low, with only 0.34 driveways per mile. This low driveway density should be preserved in order to prevent future safety problems along U.S. 20.

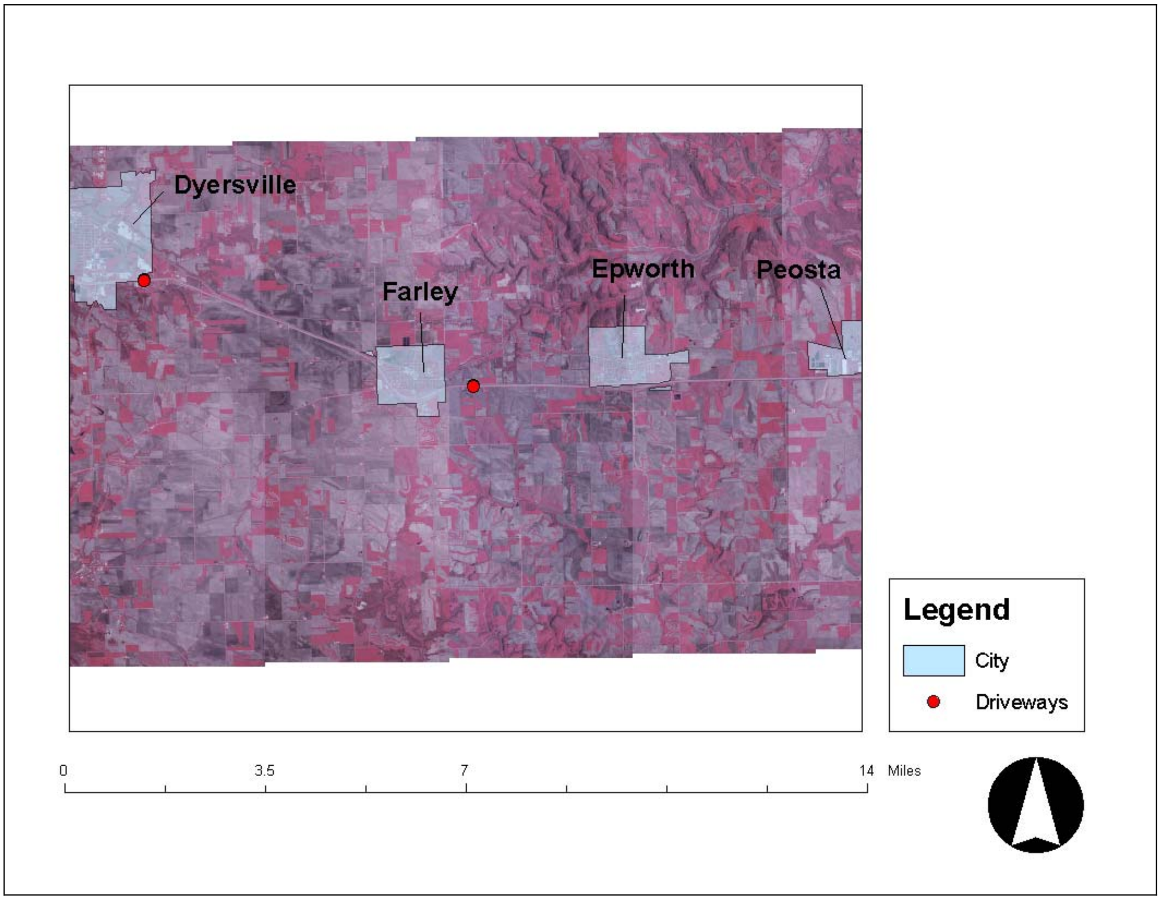


Figure A.23. Driveway locations, Segment Three

Driveway Locations and Land Use

The majority of the driveway locations, as mentioned above, are along Segments One and Two of the study area. Segment One has the highest driveway density of 4.5 driveways per mile. Both current and future land use maps show that commercial land use already dominates this portion of U.S. 20. The future land use map indicates that limited commercial growth is anticipated further west along this segment. It is likely that future additional commercial development will yield a few demands for additional driveways; however, any problems that exist on Segment One are probably there already.

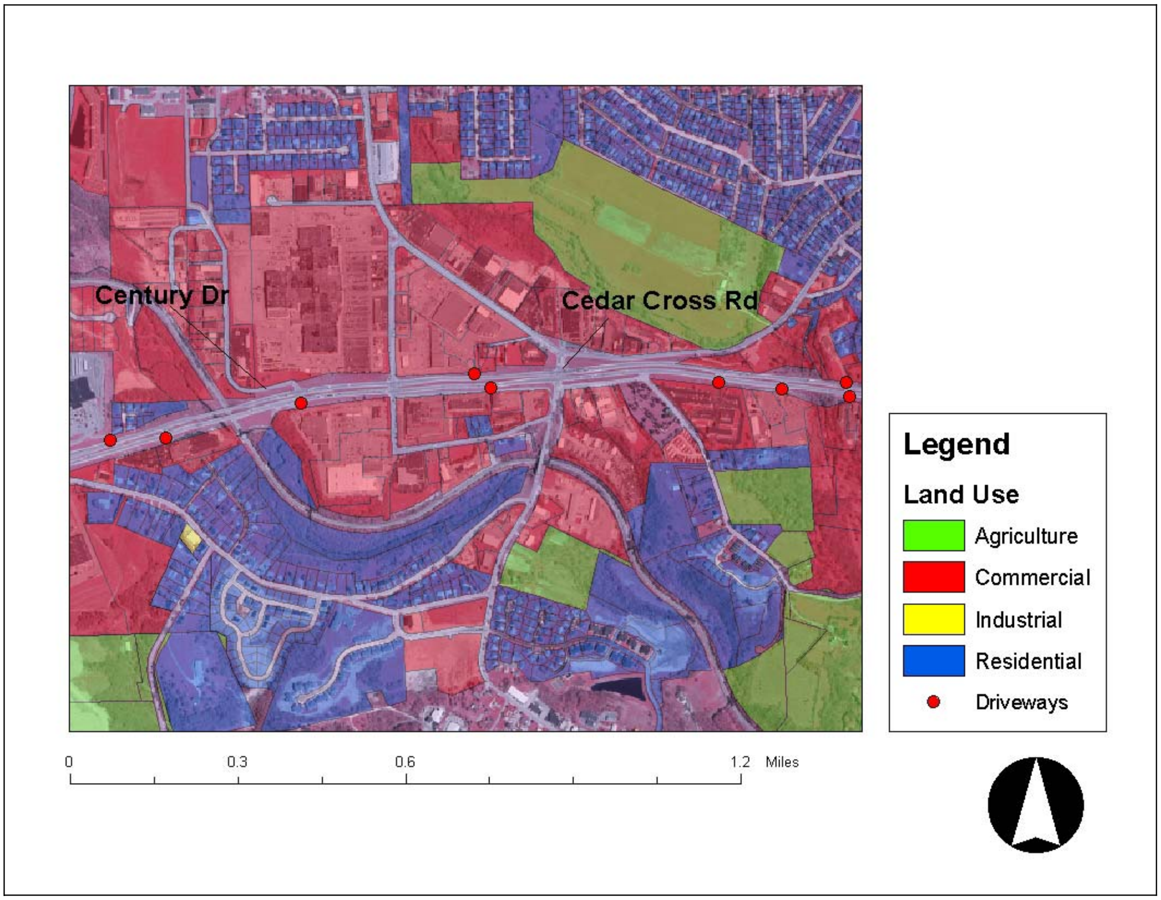
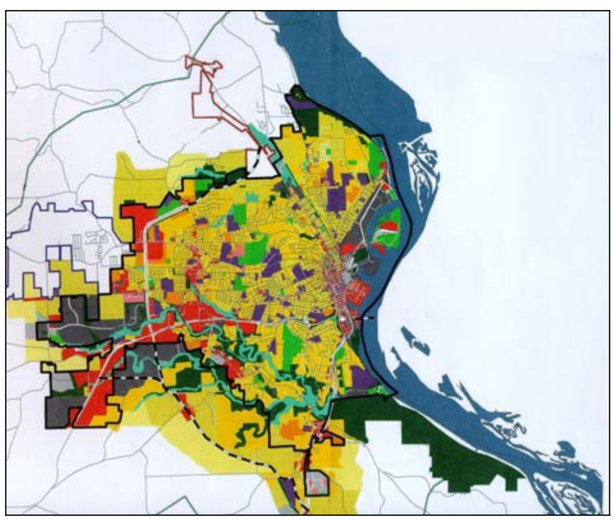


Figure A.24. Current land use and driveway locations, Segment One (Devon Drive to Northwest Arterial)



Source: Proposed Land Use Map, City of Dubuque 11/02

Figure A.25. Future land use, Segment One

Figures A.26 and A.27 indicate driveway locations and land use along Segment Two. As seen in the future land use map (Figure A.25), commercial land use is anticipated to grow west of Northwest Arterial. Spillover commercial growth from Segment One would likely result in a higher driveway density along Segment Two as well. A notable change in land use is the proposed addition of industrial uses along Segment Two. Growth of industrial uses could create new problems along Segment Two, such as additional driveways and slow moving large trucks. Another area of small growth along Segment Two is the area west of Cottingham Road. Currently, there are only a few driveway locations on this portion of the segment. The addition of commercial use would likely increase the driveway density for Segment Two. Of the three segments studied on US 20, Segment Two is by far the most likely to have future access-related safety and traffic flow problems if no changes are made and current land use trends continue.

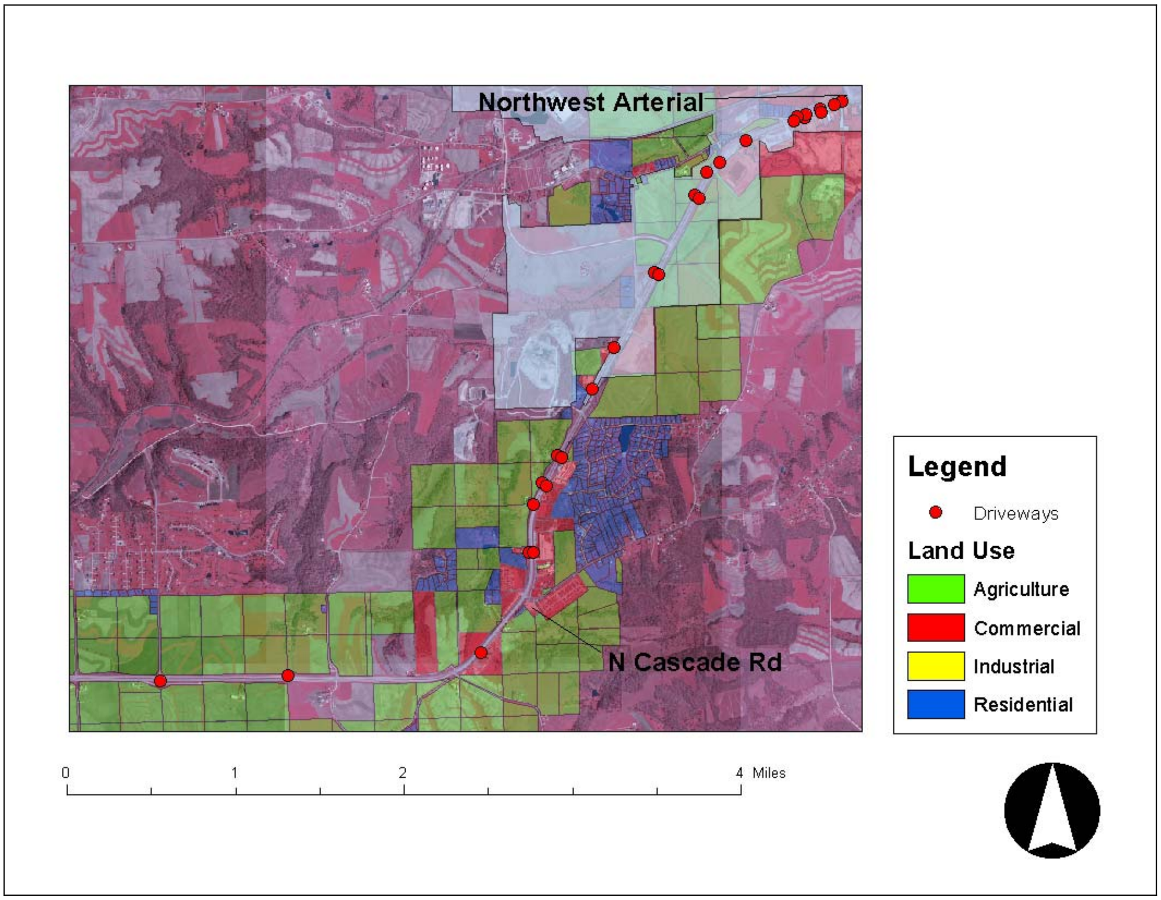


Figure A.26. Current land use and driveway locations, Segment Two

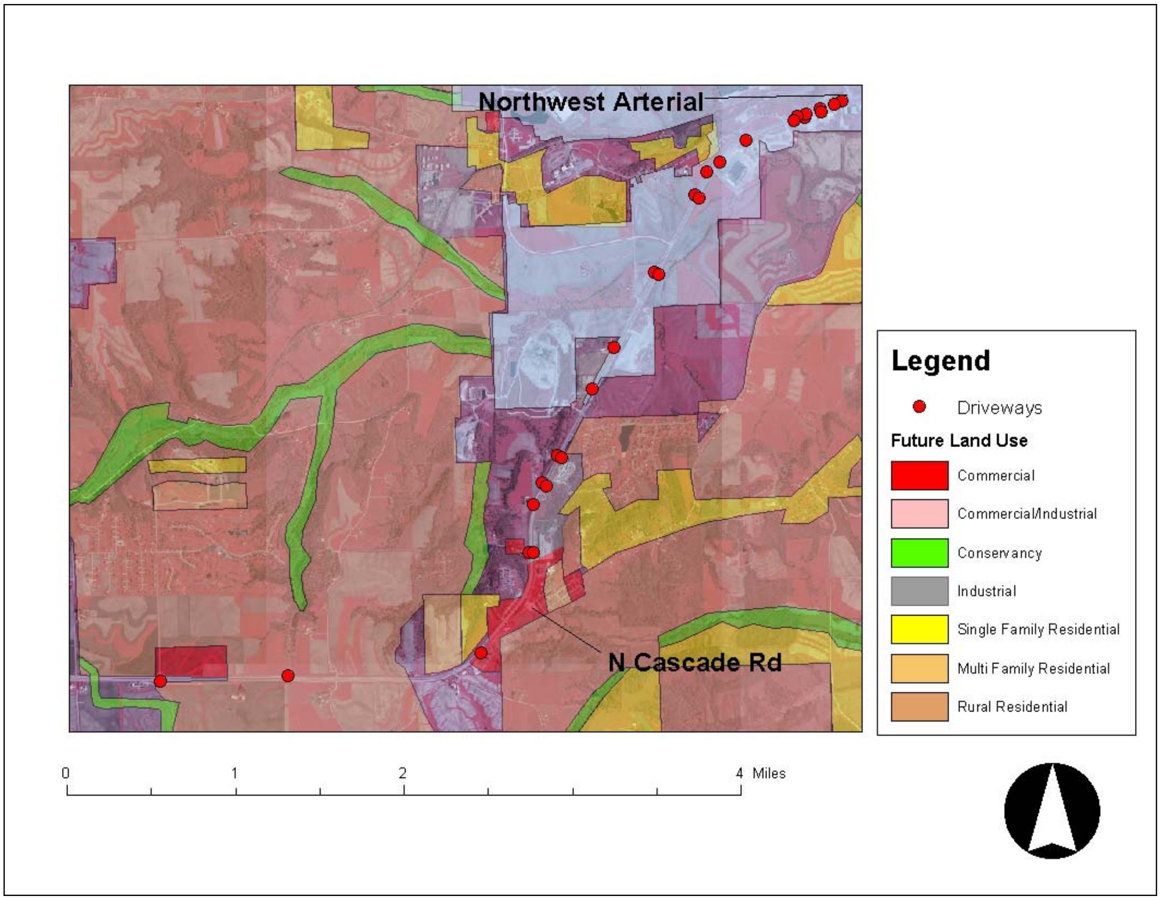


Figure A.27. Current land use and driveway locations, Segment Two

Segment Three's rural area is mainly used for agricultural purposes. Figure A.28 shows the four driveway locations along Segment Three. These driveways provide access from U.S. 20 to residential parcels east of Farley. As shown in Figure A.29, the future land use map indicates additional commercial growth south of U.S. 20 near Farley. The remaining driveways along Segment Three are located east of Dyersville near commercial and residential development.

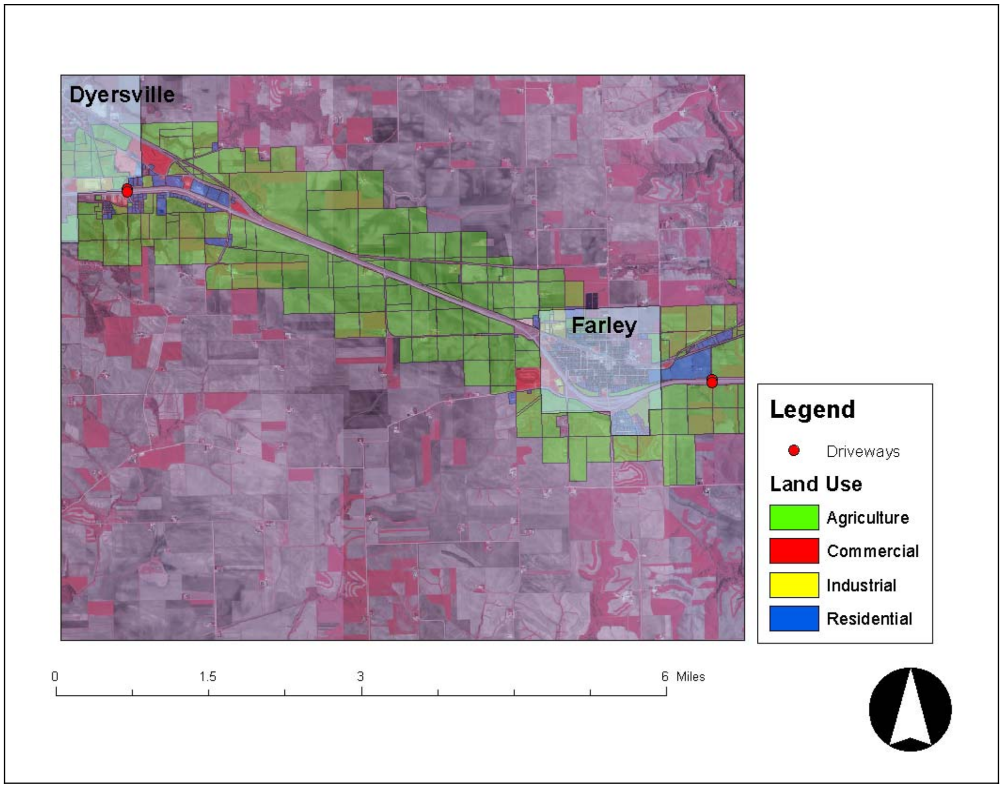


Figure A.28. Current land use and driveway locations, Segment Three

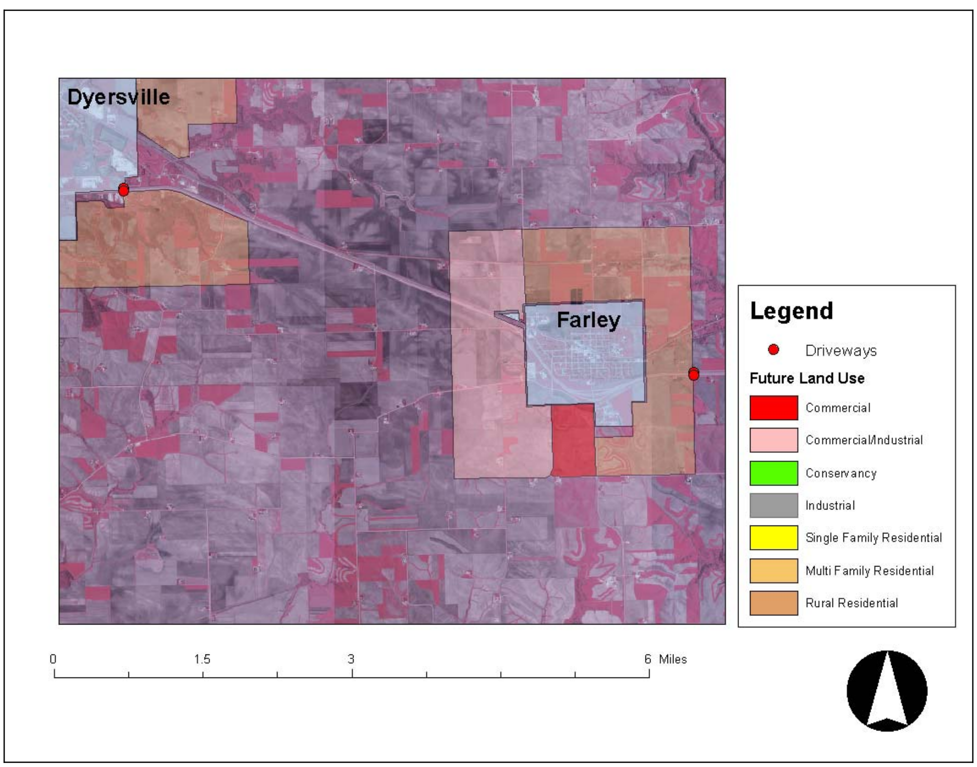


Figure A.29. Future land use and driveway locations, Segment Three

Table A.5 provides information concerning signal status and average annual daily traffic (AADT) at intersections along the corridor study area. Currently, there are only eight signalized intersections along the corridor. All these traffic signals are located within the city limits of Dubuque, and seven of them are located on Segment One. As shown in the table, AADT is highest for the roads in the urban areas, and then decreases towards the rural areas. This is the pattern that would be expected on any route that functions as a radial commuting corridor. Figures A.30 and A.31 show locations of the traffic signals; all of them fall within Segment One or Two. Six of the eight traffic signals are located within Segment One. The high density of traffic signals (and short spacing between them) is very notable in this corridor.

Table A.5. Major intersections: intersection counts and signalization status

Intersection	Signal Status	North Crossing AADT	South Crossing AADT	Eastbound AADT	Westbound AADT	Total Entering AADT
Devon Drive	Signal	3900	7000	32300	33400	76600
Brunskill Road	Signal					
Cedar Cross Road	Signal	18200	12100	31300	25700	87300
Wacker Drive	Signal	10200	7600	25100	24600	67500
Century Drive	Signal					
Menard Court	Signal	4990	11300	32100	29500	77890
Northwest Arterial	Signal	19200		23900	22900	66000
Old Highway Road	Signal	2610		20200		22810
Cousins Road	None	510		17700		18210
North Cascade Road	None			1650		1650
Swiss Valley Road	None		390	15300		15690
North Cascade Road	None		420			420
Cottingham Road	None	220	220		15300	15740
Thunder Hills Road	None	1660		15300	15300	32260
Cox Springs Road	None	440	50	15300	15300	31090
Sundown Road	None	5700	3280	16400	13200	38580
Dutch Lane Road	None	60	120			180
Lone Pine Road	None	15	25			40
Bierman Road	None	35	20			55
Center Avenue South	None	2430	210	10100	9500	22240
1st Street SW	None	2740	1360	10000	9000	23100
Bobcat Road	None	35	100		9700	9835
7th Street	None		740	9000	9000	18740
Sullivan Road	None		100			100
Wuchter Road	None		40	10200		10240
9th Street SE	None	9100	3440	9900	9600	32040

*Missing table entries indicate a lack of recent traffic counts.

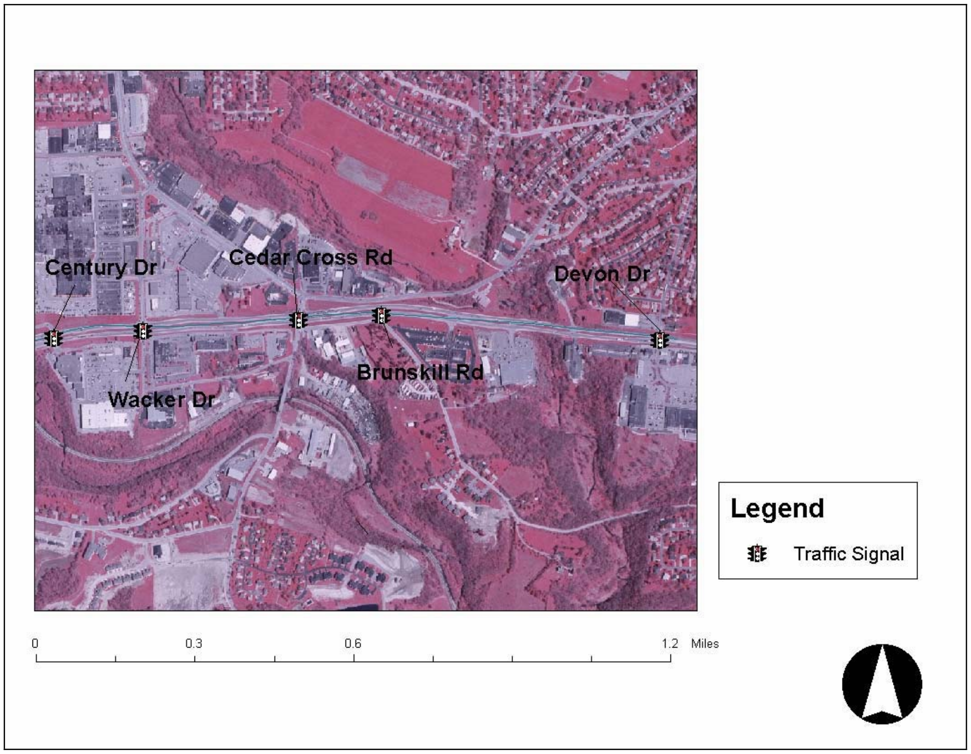


Figure A.30. Traffic signal locations, Devon Drive to Century Drive

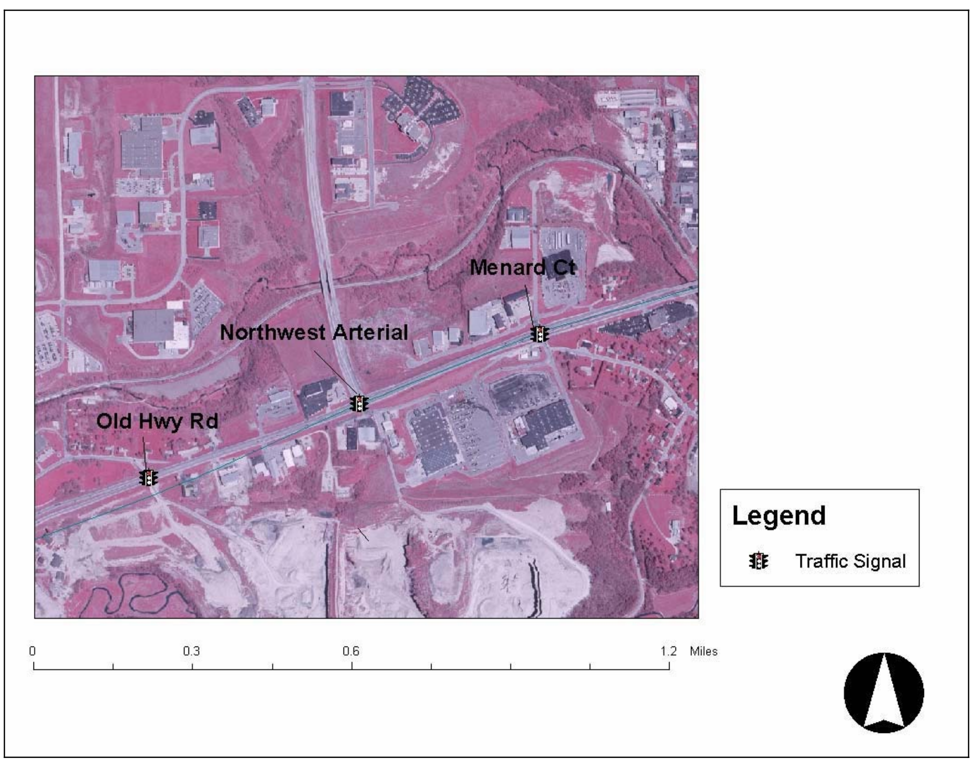


Figure A.31. Traffic signal locations, Menard Court to Old Highway Road

Crash analysis

The crash data collected for this study was found to be inconsistent, showing disproportionately low numbers of crashes in the year 1999 and extremely high numbers of crashes in the year 2000. This was assumed to be due to data collection or coding error. To control for this discrepancy, the four years of data collected for the corridor were consolidated rather than reported as separate years.

When analyzing crashes on U.S. 20, certain indicators were used to determine if crashes were due to turning movements and access control problems on the corridor. Crashes on the corridor were queried to find those that could potentially be attributed to access problems, or "probable access-related crashes." The types of crashes attributed to access problems for this study were rear end, rear end/right turning, rear end/left turning, broadside/right angle, broadside/right entering, and broadside/left turning crashes. Types of crashes clearly not attributable to access problems (e.g., animal/vehicle crashes and single vehicle run off the road crashes) were excluded.

Other important crash indicators on the corridor compared all crashes on the corridor to the probable access-related crashes to determine the safety impacts of no access control on this section of U.S. 20. In addition, probable access-related crashes are compared to all crashes for each segment of U.S. 20, created for this study. Determining the impacts of access-related crashes on each segment in turn determines how each segment of the complete corridor should be managed. For instance, plans for segments with current significant access-related crash problems should focus on physically changing access problems, while segments with no problems should be preserved so that trend continues in the future. This might be done by preparing and implementing an intergovernmental corridor management agreement and/or by encouraging improved land use planning by local governments.

Another important descriptor of the impacts of access problems on U.S. 20 is that of severity. Severity shows the estimated monetary costs of crashes on roadways based on the level of severity of each crash. Crashes that incur more damage and human injury are assessed a higher cost. Seeing crash severity for all crashes and for probable access-related crashes shows another dimension of the impacts of uncontrolled land access on U.S. 20.

Complete corridor crash statistics

Crash Frequency

Analyzing crashes on the complete study corridor of U.S. 20 in Dubuque County can compare this corridor's safety levels with other Iowa roadways. Total crashes on the complete corridor throughout the county are an important measure of overall safety levels, while analyzing access-related crashes can be used as a measure of effectiveness of U.S. 20's overall access management. For this study, "total" crashes refer to all crashes occurring on the corridor of interest. These crashes contain all crash types, and their occurrence along the route can mark all types of safety problems, not just access management problems. Conversely, "access-related" crashes are all types of crashes that relate to access problems, queried out of the total crashes on the corridor. Turning, broadside, and rear-end crashes are typically associated with access problems on roadways. The crash frequencies and rates cited in this study were computed in a geographic information system (GIS).

Table A.6 shows that between the years of 1997 to 2000, there were 366 total crashes on the complete U.S. 20 study corridor through Dubuque County. Over the four-year analysis period (1997-2000) there were varied counts of crashes per year on the corridor (see Table A.7).

Table A.6. Crash frequency per segment

	U.S. 20	Segment One	Segment Two	Segment Three
Total Crashes	366	194	108	64
Probable Access-Related Crashes	128	86	38	4
Rear End	94	67	27	0
Left Turn	7	1	3	3
Right Turn	27	18	8	1

Table A.7. Crash frequencies and breakdown of probable access-related crashes, 1997-2000

	Crash Frequency	% Of Access Crashes By Type
Total Crashes	366	-
Probable Access-Related Crashes	128	100.00%
Rear End	94	73.44%
Left Turn	7	5.47%
Right Turn	27	21.09%

The crash analysis yielded 128 access-related crashes on the U.S. 20 corridor between 1997 and 2000. Separated by crash type, there were 94 rear-end crashes, which were 73.44% of all probable access-related crashes; 7 left-turning crashes, which were 5.47% of all probable access-related crashes; and 27 right-turning crashes, which were 21.09% of all probable access-related on U.S. 20.

Crash statistics by corridor segments

Crash Frequency

Crash analysis on the entire U.S. 20 corridor is helpful to determine corridor safety problems. However, the U.S. 20 corridor has three different concentrations of land uses and driveway densities along the route. The differences could contribute to tiered levels of crash frequencies and rates found for both total and access-related crashes at different points of the corridor. As stated previously, the U.S. 20 corridor in Dubuque County could be divided into three separate segments based on growth and land development patterns. Generally, the development patterns on these three segments also correspond to total crash frequency patterns on U.S. 20. Segment One, from Devon Drive to Northwest Arterial in the city of Dubuque, is highly urbanized comparing to the rest of U.S. 20 in the county and exhibits a higher crash frequency, 194 crashes (as seen in Table A.8), than the other segments. Segment Two, from the Northwest Arterial to Peosta, is showing signs of increased development and will likely develop faster in future years; its crash frequency of 108 crashes is the next highest on U.S. 20 in Dubuque County. Segment Three, from Peosta to Dyersville, remains mostly rural and undeveloped--its crash frequency is the lowest of the U.S. 20 segments, at 64 total crashes; this occurrence is typical near major Iowa cities.

Table A.8. Crash frequencies and percentage of total crashes per segment

	Segment One	% Of Total Crashes	Segment Two	% Of Total Crashes	Segment Three	% Of Total Crashes	Total crashes All Segments
Total Crashes	194		108		64		366
Probable Access-Related Crashes	86	44.33%	38	35.19%	4	6.25%	128
Rear End	67	34.54%	27	25.00%	0	0.00%	94
Left Turn	1	0.52%	3	2.78%	3	4.69%	7
Right Turn	18	9.28%	8	7.41%	1	1.56%	27

However, the access-related crash frequencies for each segment expose access problems along U.S. 20 that may be related to how the corridor’s land uses and driveway densities have developed. Table A.8 above shows that out of Segment One’s 194 total crashes, 86 are access-related, which constitutes 44.33% of the segment’s crashes. Segment Two has 108 total crashes, with 38 access-related crashes, which comprises 35.19% of crashes on the segment. Segment Three has 64 total crashes, and only 4, or 6.25%, are access-related. The progression of access-related crash frequencies from urbanized to rural areas shows that urbanized areas on U.S. 20 experience far more access-related crashes than do the rural areas of the corridor. This also shows that Segment Three is very well managed in terms of access points and conflicts.

Dividing access-related crashes into their individual crash types provides insight into the potential causes of the crash. A profusion of a certain crash type on one corridor can highlight specific access problems on the roadway. According to Table A.8 above, Segment One had 86 access-related crashes, with 67 rear-end crashes, 1 left-turning crash, and 18 right-turning crashes. Rear-end crashes constitute 77.91% of all access-related crashes on Segment One, and these rear-end crashes are clustered together in small groups. The clustering of crashes could indicate a possible roadway or driveway problem in those locations. In addition, the crash pattern could be related to high density of signalized intersections on Segment One. Segment Two had 38 access-related crashes, 27 of which are rear-end crashes, 3 left-turning crashes, and 8 right-turning crashes. Segment Three had 4 access-related crashes, with no rear-end crashes, 3 left-turning crashes, and 1 right-turning crash. The small cluster of crashes may be the beginning of a future access problem; it should be addressed now to prevent increased problems.

However, the low numbers of access-related crashes corresponds to its land uses–U.S. 20 in this location is primarily rural, with only a few access points.

Table A.9. Breakdown of access-related crashes per segment

	Segment One	% Of Access Crashes	Segment Two	% Of Access Crashes	Segment Three	% Of Access Crashes
Probable Access-Related Crashes	86	100.00%	38	100.00%	4	100.00%
Rear End	67	77.91%	27	71.05%	0	0.00%
Left Turn	1	1.16%	3	7.89%	3	75.00%
Right Turn	18	20.93%	8	21.05%	1	25.00%

U.S. 20 in Dubuque County exhibits very different crash frequencies and types among its three segments, suggesting that each segment has unique transportation problems that may be related to its development patterns, land use, or roadway configurations. The one thing that is consistent is the relatively low number of left-turning crashes, which is a typical pattern on a multi-lane roadway with a raised or flush median like US 20.

The locations of many probable access-related crashes on the U.S. 20 corridor coincide with major public road intersections in urbanized areas. This trend is most apparent on Segments One and Two, the most urbanized segments of the U.S. 20 corridor. For instance, Figure A.32 shows the location of probable access-related crashes near Devon Drive in Dubuque, which is contained within Segment One. As Table A.5 (the major intersection table) states, Devon Drive is a signalized intersection, and Figure A.32 also shows that the majority of these probable access-related crashes are rear-end crashes. The high instance of rear-end crashes could be related to the high density of signalization because traffic frequently stops at this intersection.

Figure A.32. Probable access-related crash locations on Segment One: Devon Drive

Figure A.33 below shows a series of major intersections on Segment One in the city of Dubuque. The intersections of Cedar Cross Road, Wacker Drive, Century Drive, and Northwest Arterial have large groupings of probable access-related crashes clustered around them, which could signal an access problem. Table A.5 previously showed that all four of these intersections are signalized; in addition, these four signalized intersections are approximately one-quarter mile apart. The large number of signalized intersections within such a short distance could be contributing to the clusters of probable access-related crashes here.

Figure A.33. Probable access-related crash locations on Segment One: Cedar Cross to Northwest Arterial

Figure A.34 below shows Cousins Road, located on Segment Two outside of the city of Dubuque. This area is just within Dubuque city limits and has experienced increased urbanization lately. Cousins Road is not a signalized intersection at U.S. 20, but it has experienced a small clustering of rear-end and right-turning crashes. These crashes could be due to speed variance–traffic on this portion of U.S. 20 is generally traveling at the speed limit of 55 miles per hour and has less time to react to turning traffic. In addition to speed variance, some rear-end crashes are due to driver inattention, which could also be a factor here.

Figure A.34. Probable access-related crash locations on Segment Two: Cousins Road

Figure A.35 below shows a section of Segment Two that contains two non-signalized major intersections, North Cascade Road and Swiss Valley Road. These intersections are not within Dubuque city limits, but have experienced some degree of urbanization, as evident in the aerial photograph. The small clustering of crashes around this area involves more right- and left-turning crashes than rear-end crashes. These crashes reflect access problems with the driveways directly off U.S. 20 because the turning crashes are aligned with the driveways. As for the intersections, North Cascade Road does not have crashes clustered around it, but Swiss Valley Road does–these crashes signal that drivers may have difficultly judging turns at this intersection.

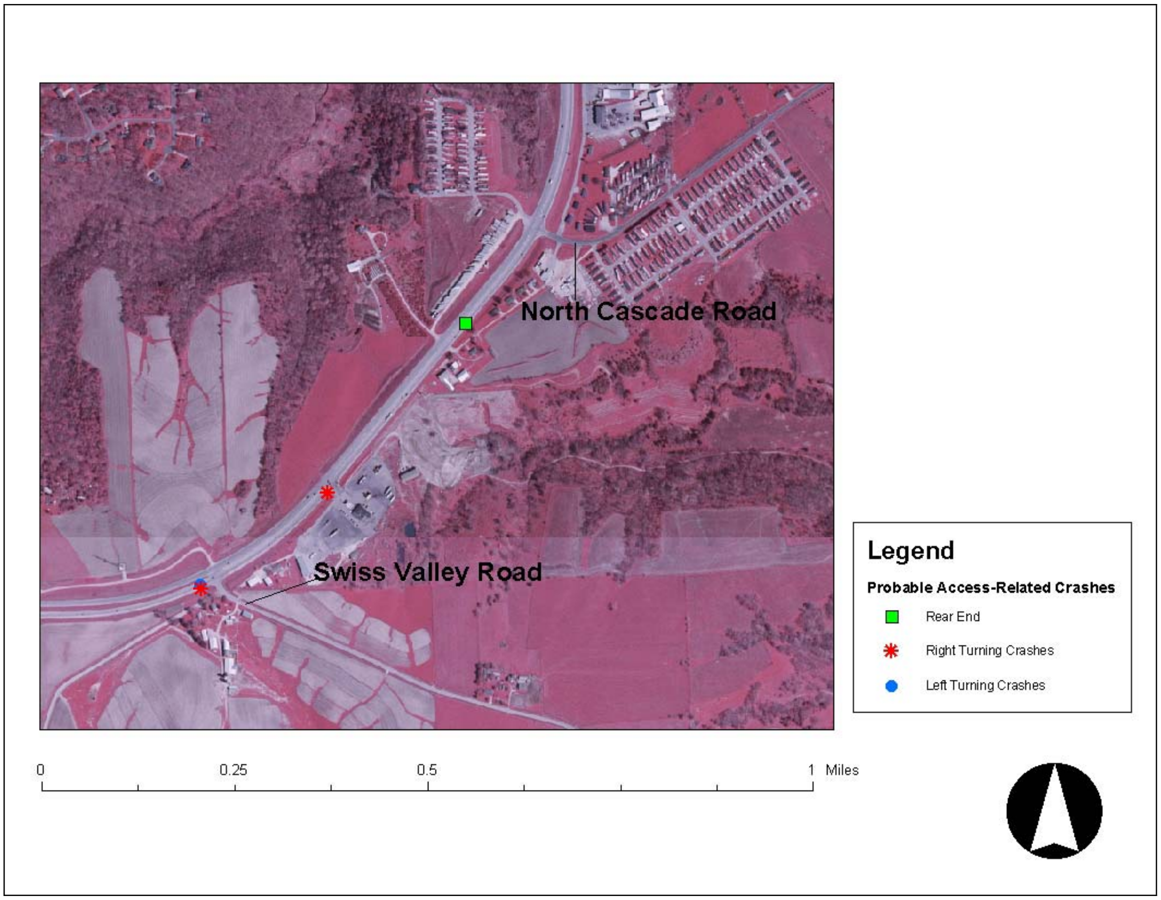


Figure A.35. Probable access-related crash locations on Segment Two: North Cascade and Swiss Valley Road

Crash Rates

Crash rates were another tool used to analyze the U.S. 20 corridor by its segments. To calculate crash rates, vehicle miles traveled (VMT) must be calculated. To calculate VMT, the analysis period (4 years multiplied by 365 days) was multiplied by the length of each individual road section, as well as by the average annual daily traffic counts (AADT) (weighted by length) of the road section. The resulting VMT was for individual road sections, and the VMT was summed for each of the three segments of U.S. 20.

Table A.10. AADT, VMT, and Segment length

	Segment One	Segment Two	Segment Three
AADT	24,558	16,039	9,607
VMT	74,033,680	176,217,036	213,272,858
Segment Length	2.00	7.50	14.910

The results of the AADT counts and the VMT calculation, both as compared to segment length, are seen above in Table A.10. The VMT, when compared to segment lengths, provides a sense of the most heavily traveled segments of the U.S. 20 corridor. Segment Three is by far the longest segment at approximately 15 miles, with the highest VMT of over 213,000,000. The highly urbanized Segment One is only two miles long with a VMT of over 74,000,000 suggesting a higher density of traffic than in the rural areas. Segment Two is approximately 7.50 miles in length with a total VMT of over 176,000,000.

Crash rates were then calculated using the VMT figures shown previously. To find crash rates, the crash frequency per corridor was first multiplied by one million, and then divided by the VMT, summed per corridor. The resulting crash rate is the approximate number of crashes that occurred in the two-year time period on the corridor per million vehicle miles. Table A.11 shows the total and probable access-related crash rates. A qualitative assessment is provided of how significant the current access-related crash rate is. Only on Segment One the current level of access related crashes is significant, and the problem here appears to be associated with public road intersections and the high density of traffic signals rather than with commercial driveway density.

Table A.11. Crash rates by segment per million vehicle miles (1997-2000)

	Segment One	Segment Two	Segment Three
Total Crash Rate	2.62	0.61	0.30
Probable Access-Related Crash Rate	1.16	0.22	0.02
Qualitative Assessment	Moderate	Low	Very Low

*Per million vehicles

All the total and access-related crash rates shown in the above tables show a definite crash trend related to urbanization and land use on the U.S. 20 corridor. In both cases, Segment One, the most urbanized segment, showed higher total and probable access-related crash rates than the other segments, even though vehicle miles traveled are highest for Segment Three. The next most-highly urbanized segment, Segment Two, also had the next-highest crash rates. Segment Three had the lowest crash rates for both total and access related crashes. These crash rates show that Segment One currently has a modest problem with probable access-related crashes, Segment Two has a minor but potentially growing problem with these crashes, and Segment Three does not have a problem at all at this time.

Crash Severity

While analyzing crash locations, frequencies, and rates are beneficial to understand safety issues on U.S. 20, determining the severity of crashes provides insight on the gravity of crashes and how they monetarily impact communities and drivers. Different levels of crash severity incur an estimated cost to society, and these costs can be totaled per corridor to provide an estimate of the monetary cost of these crashes on U.S. 20. The severity levels and their corresponding cost in dollars used for this study are fatality crashes at $1 million each, major injury crashes at $150,000 each, minor injury crashes at $10,000 each, and possible injury or property damage only crashes at $2500 each.

Table A.11. Severity per segment for total crashes

	Segment One	Segment Two	Segment Three	U.S. 20
Total	$14,897,500	$8,912,500	$5,545,000	$29,355,000

Table A.12. Severity per segment for probable access-related crashes

	Segment One	Segment Two	Segment Three	U.S. 20
Total	$7,642,500	$4,725,500	$340,000	$12,708,000

The crash severity calculations show that the severity of crashes differed greatly on each segment. In total crashes, Segment One accrued the highest severity costs, with Segments Two and Three close behind. The probable access-related crash severity costs do not follow this trend. This is because Segment Three has essentially no access-related crashes but does have a significant amount of other serious crashes, as might be expected on a high-speed rural route.

Corridor Management Issues along Segment One

- Current Issues
    - High density of public road intersections and median openings in the City of Dubuque
    - High density of traffic signals
        - Spaced less than 0.5 miles apart
    - Lack of turning lanes at major intersections
    - Discontinuous frontage road system that is too close to the mainline
- Future Issues
    - Current problems with rear end collisions, low mean travel speeds, and congestion will likely grow worse as AADT increases and intersection level of service (LOS) drops
    - Land use pattern is largely established (area is built-out), so redesigning access is difficult

Few direct driveway accesses could be closed or consolidated. If the number of commuters along U.S. 20 continues to increase, Segment One will experience numerous negative changes. Current problems with access-related crashes (primarily rear-end collisions), low average travel speeds, and congestion will likely get worse if the AADT increases along the urban portion of U.S. 20. The LOS along this segment will likely decrease with increased traffic.

The most concerning issue along Segment One is the high amount of access related crashes, particularly rear-end crashes. As shown previously, there are numerous rear-end collisions concentrated around the intersections of Devon Drive, Cedar Cross Road, Wacker Drive, Century Drive, and Northwest Arterial. Figure A.36 shows the closeness of traffic signals along Segment One. Some of the signals are less than a half-mile distance from one another.

As shown in maps throughout this study, there is a high density of public road intersections along Segment One. There is also a high density of median openings along Segment One. Access-related accidents are more prone to occur in the areas where medians and intersections are located. At some major intersections there is a lack of turning lanes, which causes congestion and can potentially cause collisions. Many of the intersections along Segment One are at or approaching a LOS of D, which could be remedied by adding turn lanes. LOS D and E at an intersection is where there is little maneuverability due to congestion, and LOS F is breakdown of traffic flow (ITE, Transportation Planning Handbook).

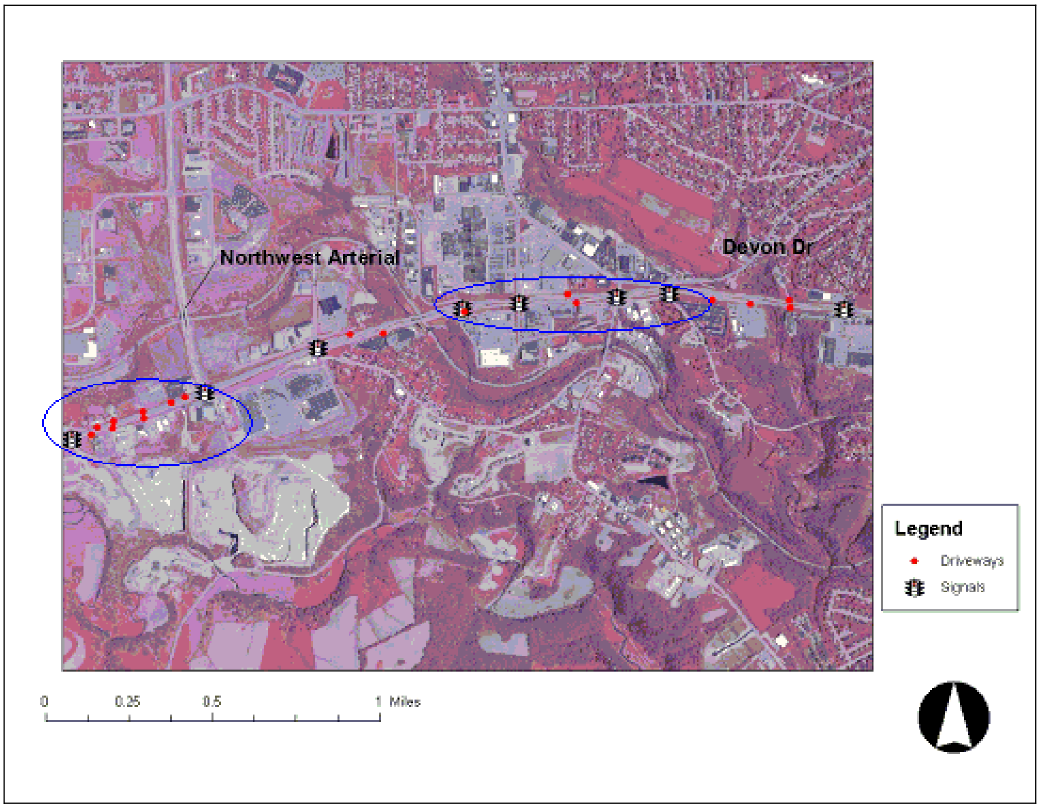


Figure A.36. Signal spacing less than 0.5 mile, Segment One

Low mean travel speeds are also an issue along Segment One. The posted speed limit along Segment One is generally 35 miles per hour. However, traffic tends to move at lower average speeds due to congestion and the numerous traffic signals. At peak hours, generally around 8-9 in the morning and 4-5 in the evening, there is usually a higher volume of traffic (commuters), which slows the average speed. The quantity of traffic signals and distance between major intersections and access points also tends to slow the speed along Segment One. Some of the signals are spaced less than 0.5 miles apart, which does not support a 35 to 45 mile per hour progression, especially with the hilly terrain along Segment One.

As shown previously, there are numerous commercial access points along Segment One. Ideally these access points would not exist directly off U.S. 20, rather off of frontage or backage roads. Since the land use pattern is established and the area is built-out, redesigning commercial access would be difficult at this point.

Segment One Solutions

There are several locations where access can be improved along Segment One. The use of frontage or backage roads and shared driveways are possible solutions to these access problems. Frontage or backage roads are a good solution for Segment One, since the alternatives are slim because the segment is already built up. Figure A.37 shows a possible frontage road to the south of U.S. 20, which extends west of Devon Drive. This particular frontage road would eliminate two driveways with direct access to U.S. 20. This frontage road could deter further access-related crashes occurring along this portion of Segment One.

Figure A.37. Possible frontage road, Segment One

Figures A.38 and A.39 show two other possible frontage roads for Segment One. To the south of U.S. 20, a frontage road could be applied from Wacker Drive to numerous commercial parcels to the west. Another possible frontage road, as shown in the Figure A.39, to the north of U.S. 20, could be used to connect Menard Court to a few commercial parcels to the east. The elimination of driveways could reduce the number of access-related crashes that occur along this portion of Segment One.

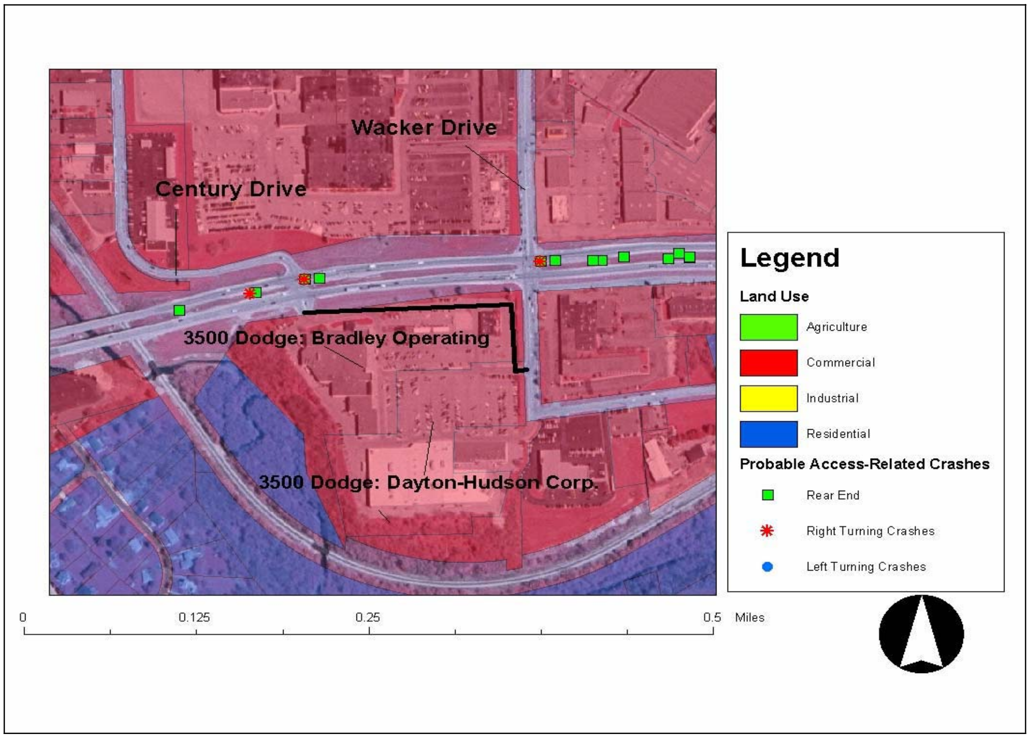


Figure A.38. Possible frontage road, Segment One

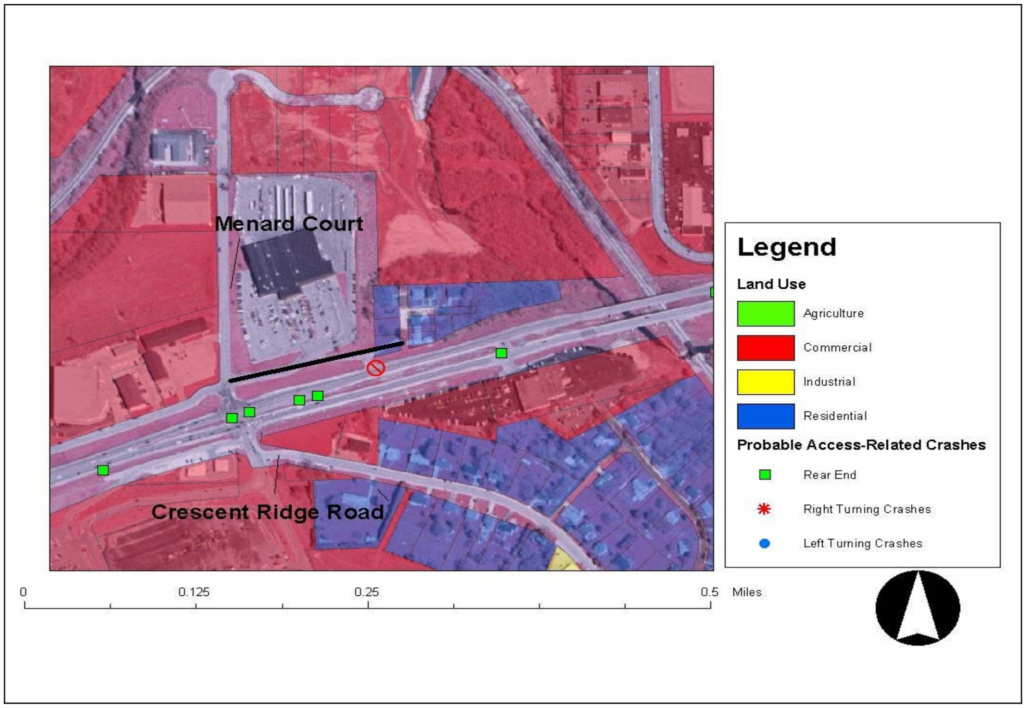


Figure A.39. Frontage road and access elimination, Segment One

Currently, there are few opportunities available for traffic signal removal along Segment One. Additional signals along Segment One would likely not provide beneficial services to the segment. It is important to avoid placing new signals along the segment and preserve the current signal density.

As shown earlier, many of the access-related crashes occurred at the major intersections along Segment One. To remedy this, turning lanes could be applied. The addition of turning lanes could also improve the LOS at the intersections, which would increase the average travel speed by separating the turning traffic from the thru traffic.

Corridor Management Issues along Segment Two

- Current Issues
    - Several areas with direct driveway accesses that could be closed or consolidated
    - Discontinuous frontage road system
- Future Issues
    - High likelihood of greater density of commercial and residential land development leading to higher density of public road intersections and driveway density

Compared to Segment One, segment two has less access-related problems. There are a few locations with direct driveway access to U.S. 20 that could be closed or consolidated. As Figure A.40 shows, there are numerous access points along Segment Two from Northwest Arterial to Peosta. However, the access along Segment Two is not as troublesome compared to Segment One. As noted already, both Segments One and Two have rather low driveway densities, but it is of importance to preserve these and reduce driveways where possible.

One of the biggest issues along segment two concerns the possible growth of future commercial use. The future land use map indicates expansion of commercial use from Segment One into Segment Two to around the area of New Castle Road. Additional commercial use in Segment Two could have numerous negative results on U.S. 20 from a safety perspective. Examples of negative impacts could include increased commercial driveways, higher AADT, additional traffic signals, lower average speeds, lower LOS, and increased access-related crashes.

Figure A.40. Driveway locations, Segment Two

Another concern along Segment Two is the current number of access-related crashes, particularly rear-end crashes. There are two locations of primary concern along Segment Two, shown in Figures A.41 and A.42. The first location is the area to the west of Northwest Arterial, which shows numerous access related crashes, most rear-end crashes with some right turn crashes. This abundance of rear-end crashes is likely the result of numerous factors including driveway spacing, traffic signals, and median openings. The second area of concern is located from North Cascade Road to Swiss Valley Road. As shown in Figure A.42, there are only a few access-related crashes here. However, this area is of concern because the future land use map indicates additional commercial use.

This area would likely be more vulnerable to access-related crashes as the result of commercial development. Providing commercial development occurs, two other areas of concern are at the intersections of U.S. 20 and Cottingham Road and Thunder Hills Road. As Figure A.43 shows, these areas display only a few probable access-related crashes. However, in the case of commercial growth extending this far, these locations would be of major concern.

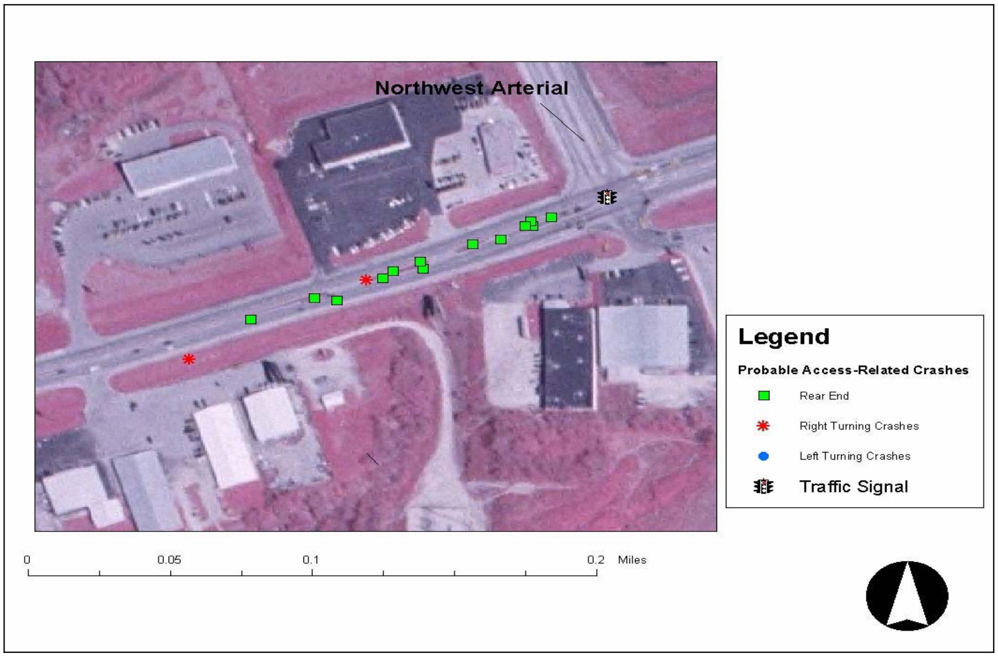


Figure A.41. Probable access-related crashes: Segment Two, Northwest Arterial

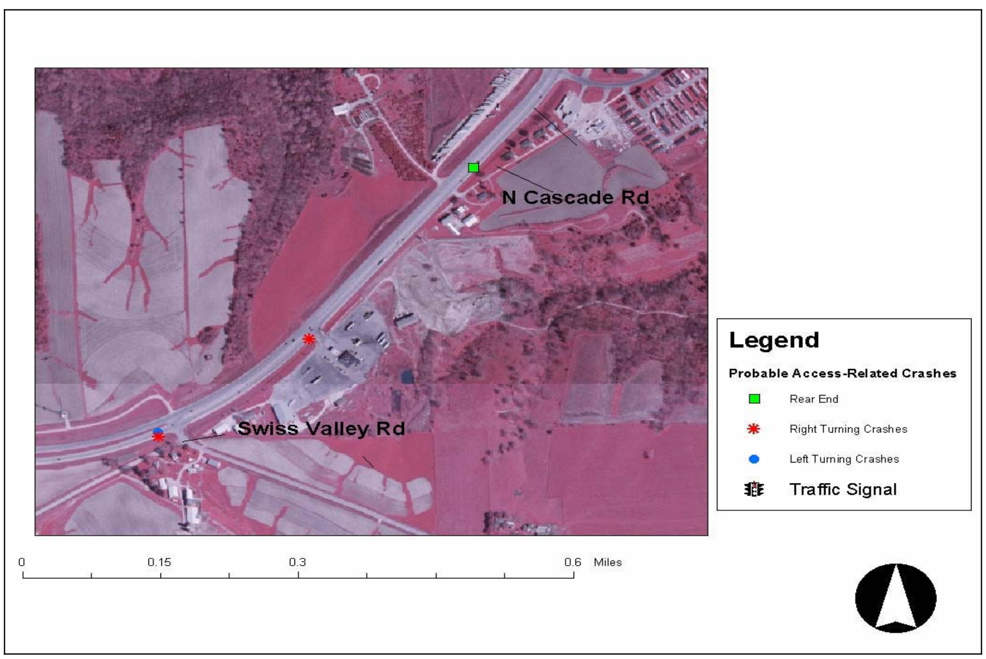


Figure A.42. Access-related crashes from North Cascade Road to Swiss Valley Road, Segment Two

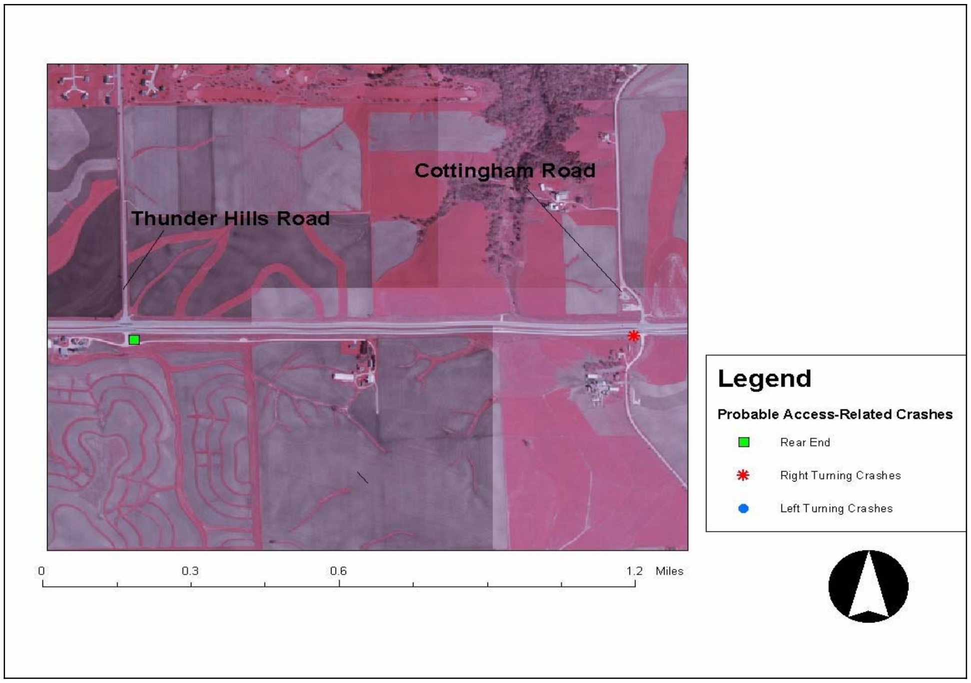


Figure A.43. Access-related crashes from Cottingham Road to Thunder Hills Road, Segment Two

Potential Corridor Improvements: Segment Two

There are several locations where access can be improved along Segment Two. Frontage or backage roads and shared driveways could also be used to eliminate certain access locations along U.S. 20. Figure A.44 shows a possible frontage road that could be applied to connect several commercial parcels to the north of U.S. 20, just west of Northwest Arterial. This frontage road would eliminate one driveway and provide access to four commercial parcels.

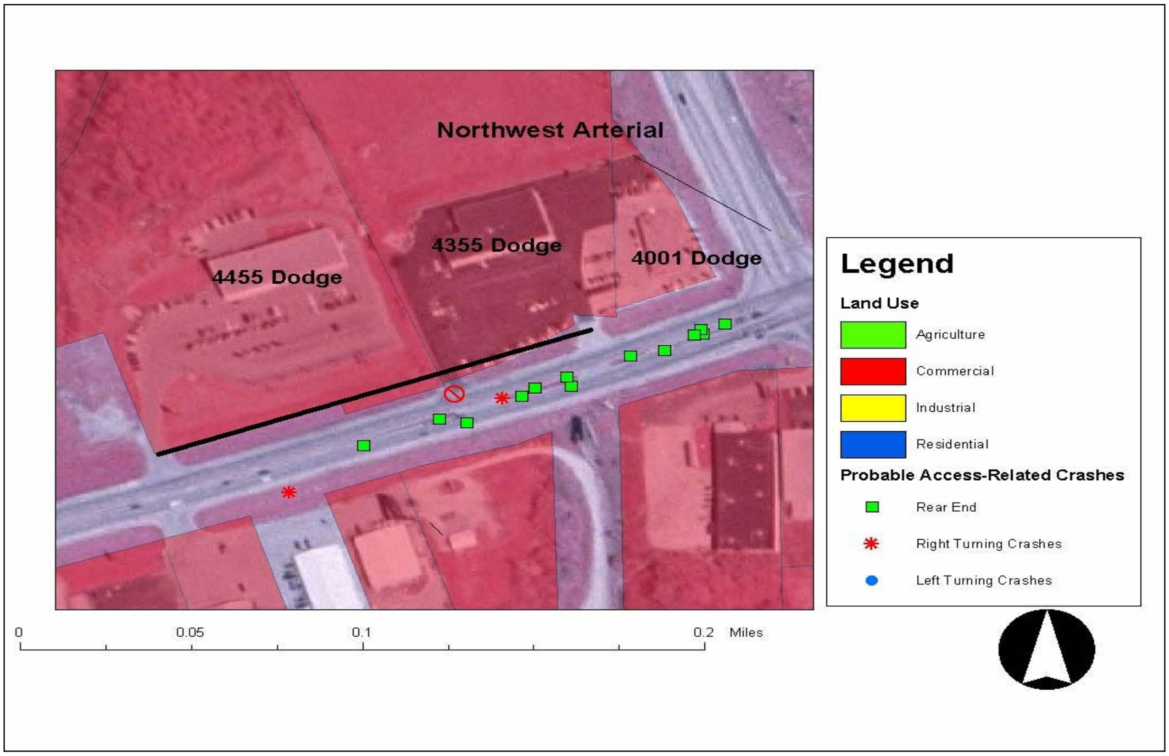


Figure A.44. Possible frontage road, Segment Two

Another possible frontage road is shown below in Figure A.45, located to the north of U.S. 20 and extending west form Northwest Arterial. This frontage road would be approximately .40 miles in length, providing access to numerous commercial lots. The application of this frontage road would eliminate the two driveways shown below, which could result in less access-related crashes along this portion of the segment.

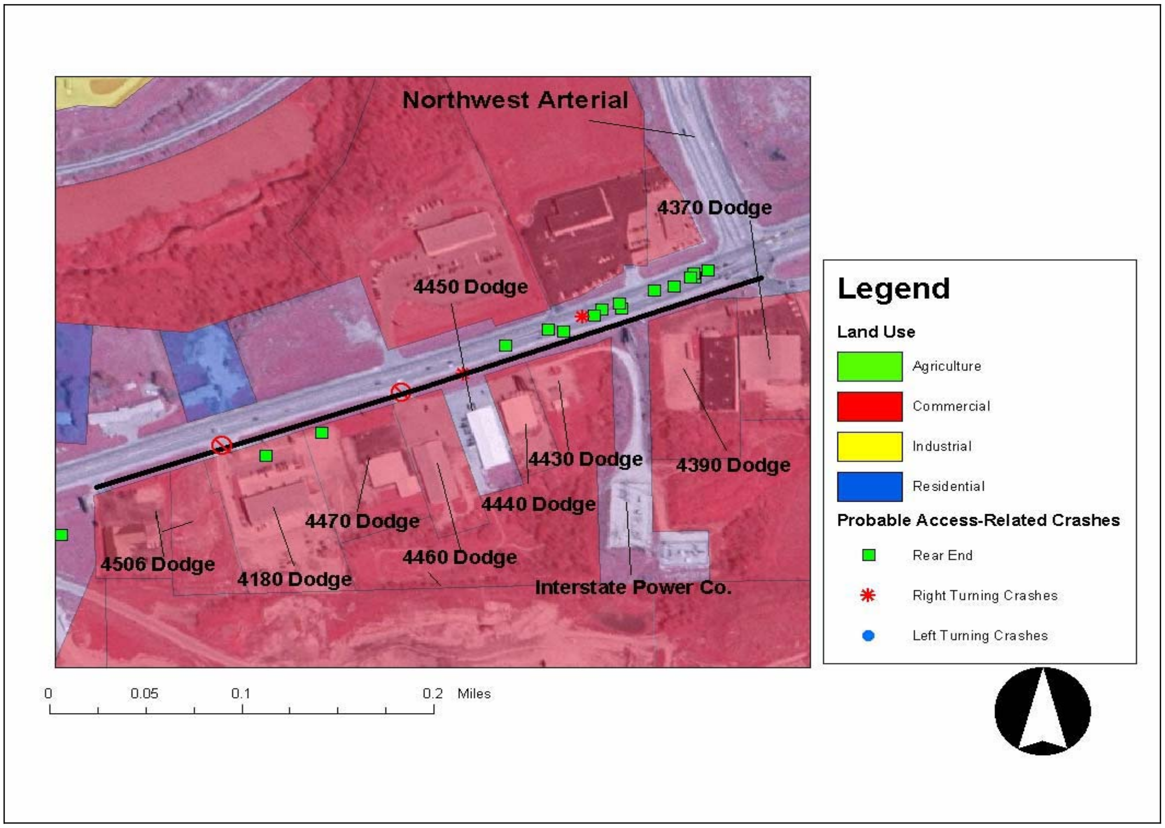


Figure A.45. Possible frontage road, Segment Two

Another possibility for a frontage road along Segment Two is shown below in Figure A.46. This frontage road extends to the east of North Cascade Road, south of U.S. 20. This land is currently used for commercial use. However, the future land use map indicates additional industrial use. A frontage road would work well in this situation to eliminate slow traffic generated from the industrial use. The frontage road would remove two driveways with direct access to U.S. 20.

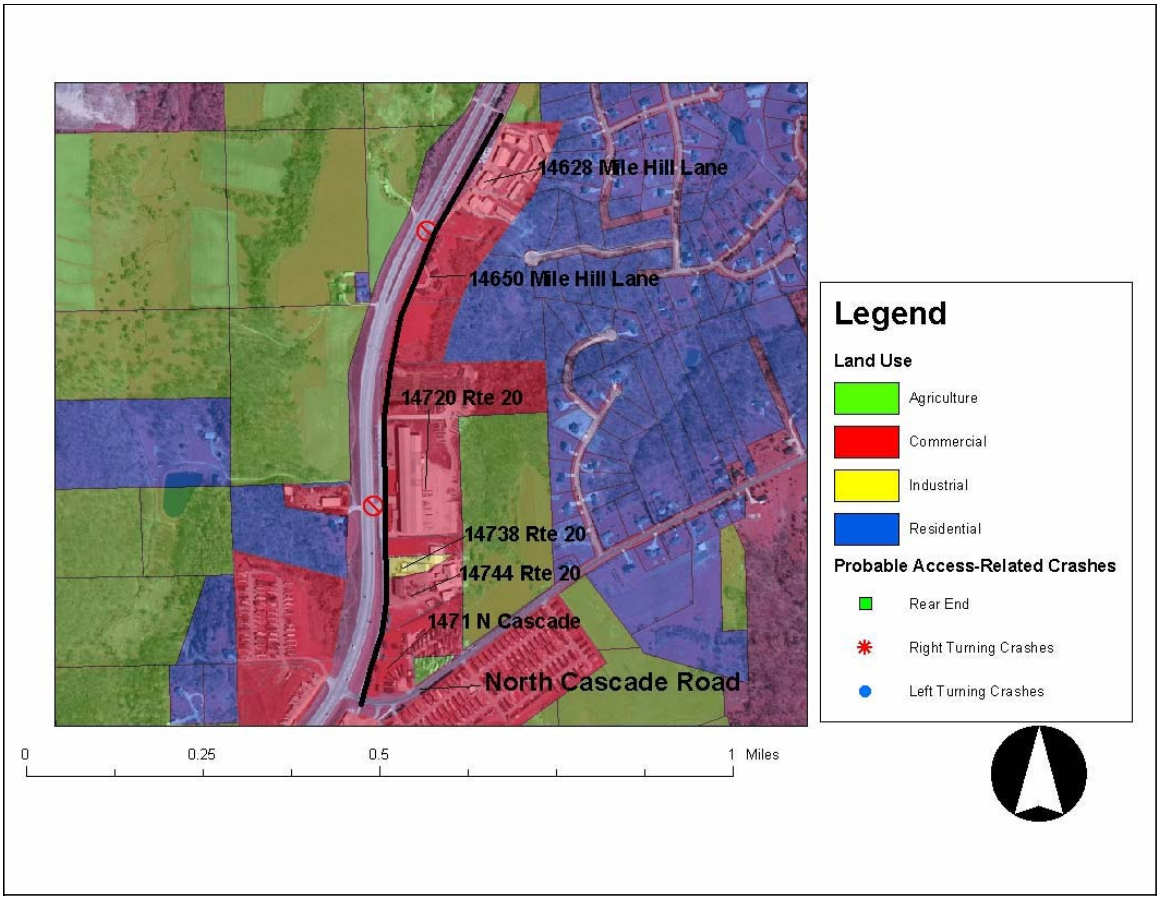


Figure A.46. Possible frontage road, Segment Two

In addition to the application of frontage roads, guiding future growth is important. As shown in the figures above, in the areas to the west of Northwest Arterial and from North Cascade Road to Swiss Valley Road, there are numerous access-related crashes. These areas will only suffer if additional commercial growth occurs. To resolve this, an intergovernmental agreement could help deter future problems from arising. It is important not only to preserve this segment, but also to deter from access problems.

Corridor Management Issues along Segment Three

- Current Issues
  - "Spot" issues near Epworth (east side), and Farley (west side)
- Future Issues
  - Current "spot" issues in and near cities could become larger problems as land development occurs

Segment Three, the rural corridor, currently does not have any troublesome access-related areas. There are a few "spot issues" concerning land use near Epworth and Farley. As shown in Figure A.47, there are only three locations with access from U.S. 20. Of the access locations along this segment, they display good access management techniques, such as shared residential driveways from U.S. 20, as displayed in Figure A.48. The biggest concern for this segment would be preserving its integrity by deterring future growth.

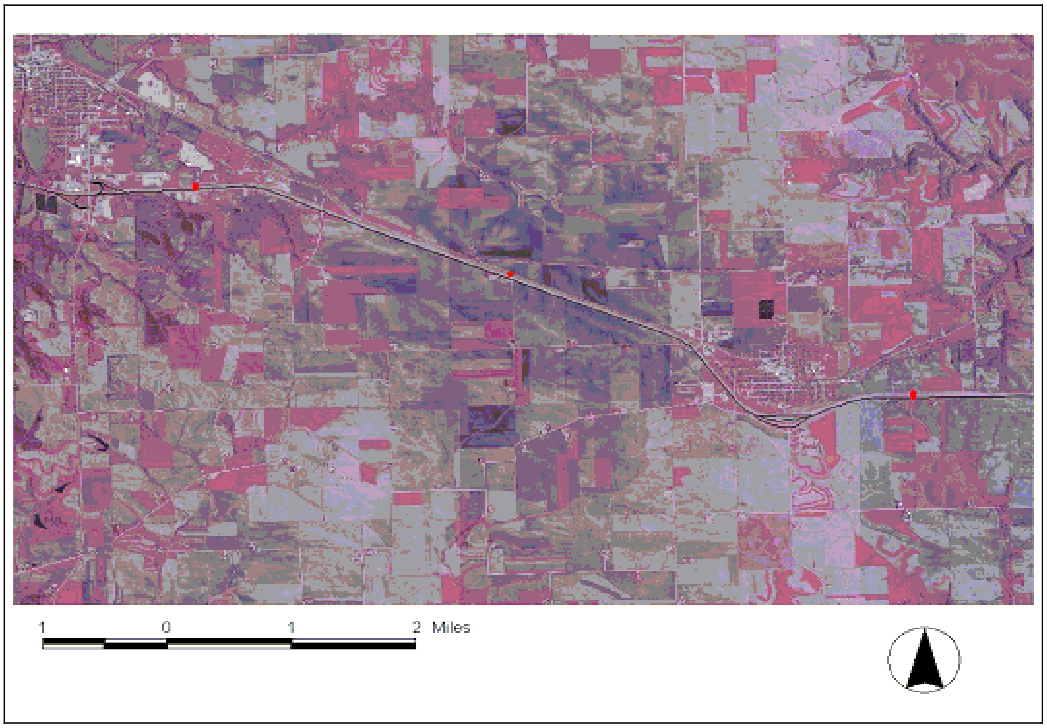


Figure A.47. Driveway locations, Segment Three

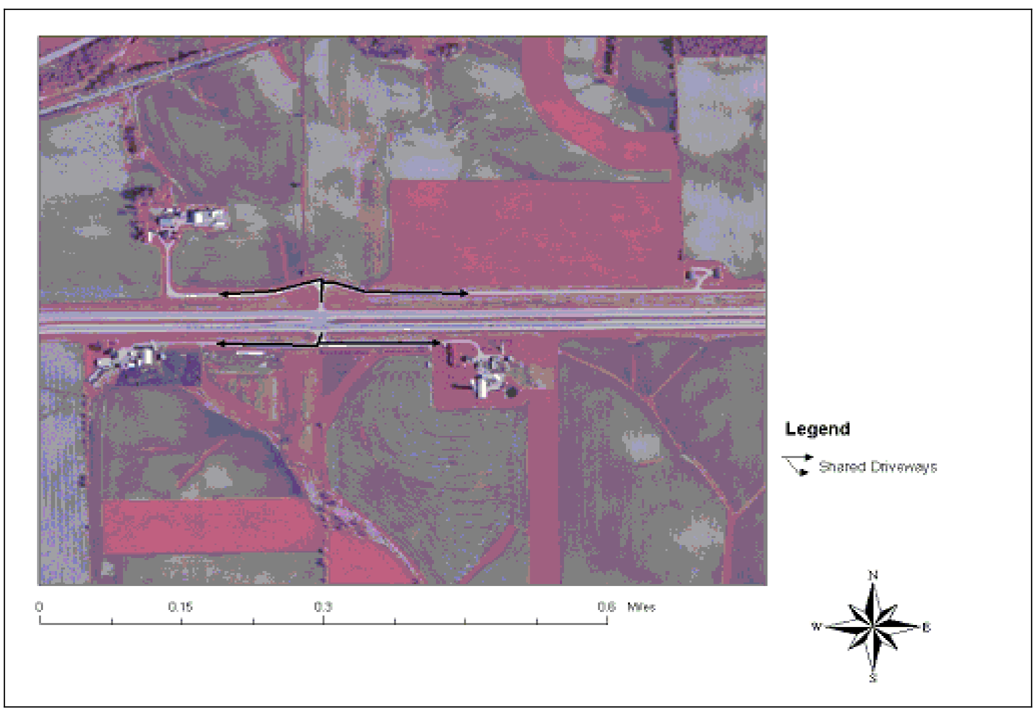


Figure A.48. Shared residential access, Segment Three

Potential Corridor Improvements: Segment Three

Because there are currently no access problems along Segment Three, the best solution would be to preserve this roadway in order to keep access points to a minimum. As the future land use map indicates, there is room for growth around the cities of Epworth and Farley. A strategy would be to consider this in the land use plan and set restrictions (agreement) against further access along Segment Three of U.S. 20.

Overall Corridor Management Goals

Below are some goals for the U.S. 20 corridor. Some goals are more attainable than others. However, the desired outcome would result from the success of all of the following goals being accomplished.

1. Reduce at-grade public road intersection density (full intersections), full median break density, and traffic signal density along Segment One.
2. Reduce direct driveway accesses where possible. This can be done through driveway sharing and alternative access way development.
3. Orient driveways away from interchanges and major intersections where possible.
4. Develop a complete frontage and backage road system where appropriate with a substantial separation from the mainline.
5. Improve land use planning along developing and rural portions of Segment Two and Three, so that new commercial developments cluster around existing planned interchanges.

The ideal configuration for the U.S. 20 corridor would consist of an urban expressway (Segment One) and a suburban/rural expressway (Segments Two and Three). Segment One would be an urban expressway with full access control. A full frontage road system providing access to the mainline would be accessed at interchanges along U.S. 20 with at least 0.5 to 1.0 miles apart between interchanges. This urban expressway would have a higher mean travel speed (55 miles per hour) with no traffic signals or direct access.

The suburban/rural expressway would have a high level of access control along Segments Two and Three. With this configuration, a backage road system with accesses to the mainline would be available, with accesses at least 1.0 mile apart. Along Segment Two, the only access points would be the interchanges. For Segment Three, driveway spacing would be at least 0.5 miles apart and consist of only right-in right-out turning movements. Ideally, there would be no traffic signals along this portion of the corridor. However, if necessary, there would be a minimum of at least 1.0 mile between signals. The suburban/rural expressway would allow for higher mean speeds of around 55 to 65 miles per hour.

APPENDIX B: IA 163 POLK/JASPER CORRIDOR MANAGEMENT ANALYSIS AND PROPOSED APPROACHES

Project Area Land Use and Traffic Conditions

Study Area

For this study, Iowa 163 was split into three segments according to land use. Segment One is approximately two miles in length, classified as the urban segment extending from Williams Street to U.S. 65 in Pleasant Hill. Segment two extends approximately 13 miles west of U.S. 65 to Prairie City. It is identified as the developing or suburban segment for the study due to growth from Des Moines and Pleasant Hill. Segment Three is approximately 10 miles long, extending from Prairie City to Monroe. Segment Three is distinguished from the other segments because of the rural setting along the corridor. Figure B.1 shows a map of the corridor study area by segment (Segment One=red, Segment Two=black, and Segment Three=blue).

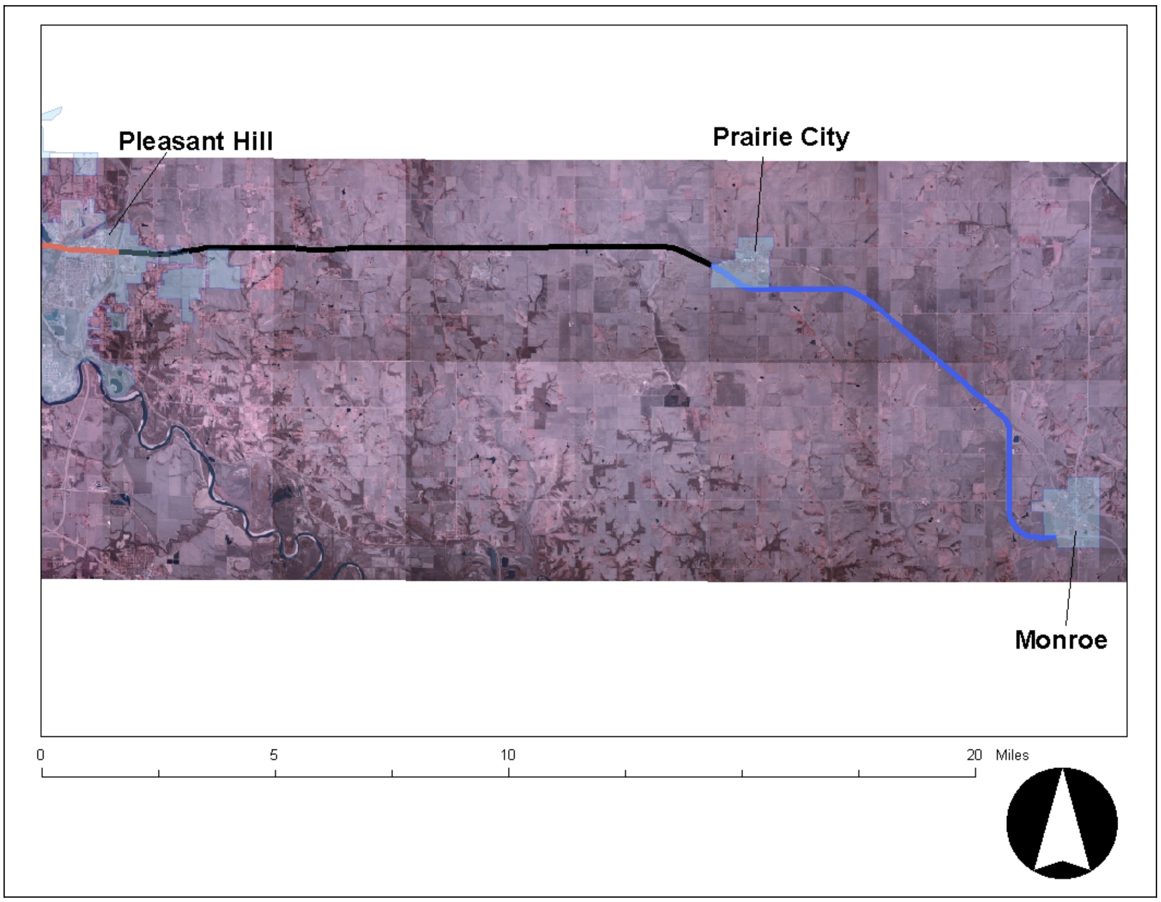
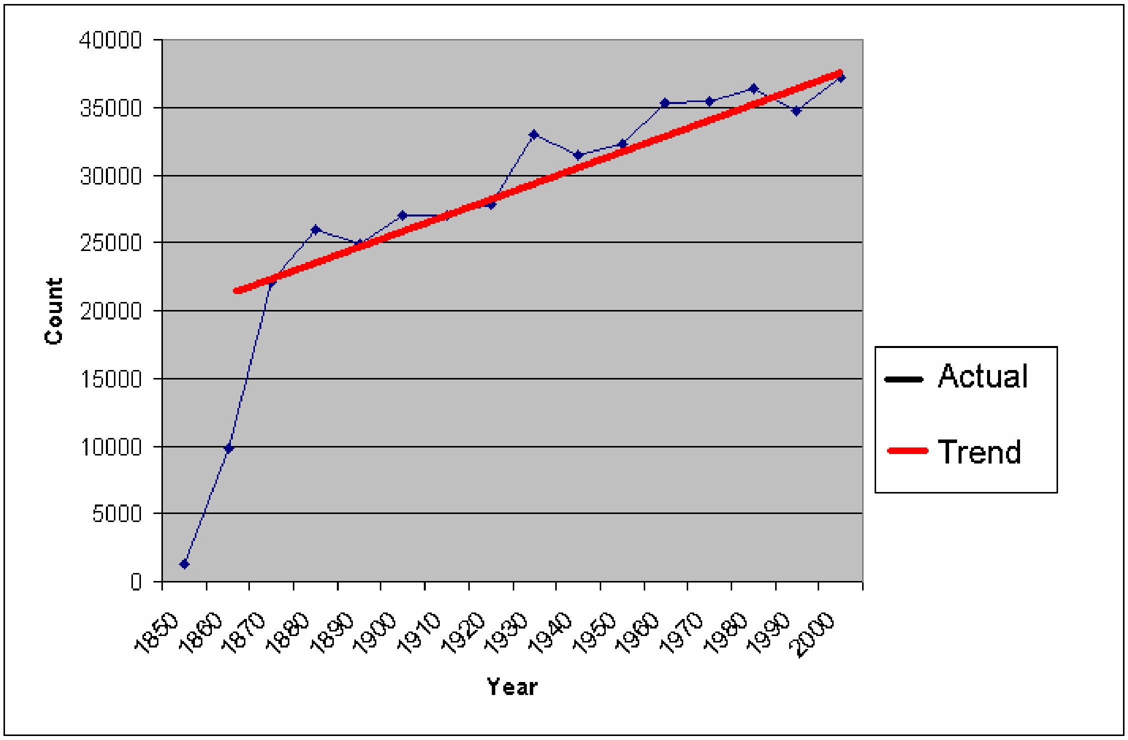


Figure B.1. Iowa 163 study area

Population

The population of Jasper County has been following a gradual upward trend for decades. The U.S. Census indicated that Jasper County's population totaled 1,280 persons in 1850. From 1850 to 1880, the population for the county increased by a total of 24,683 persons.

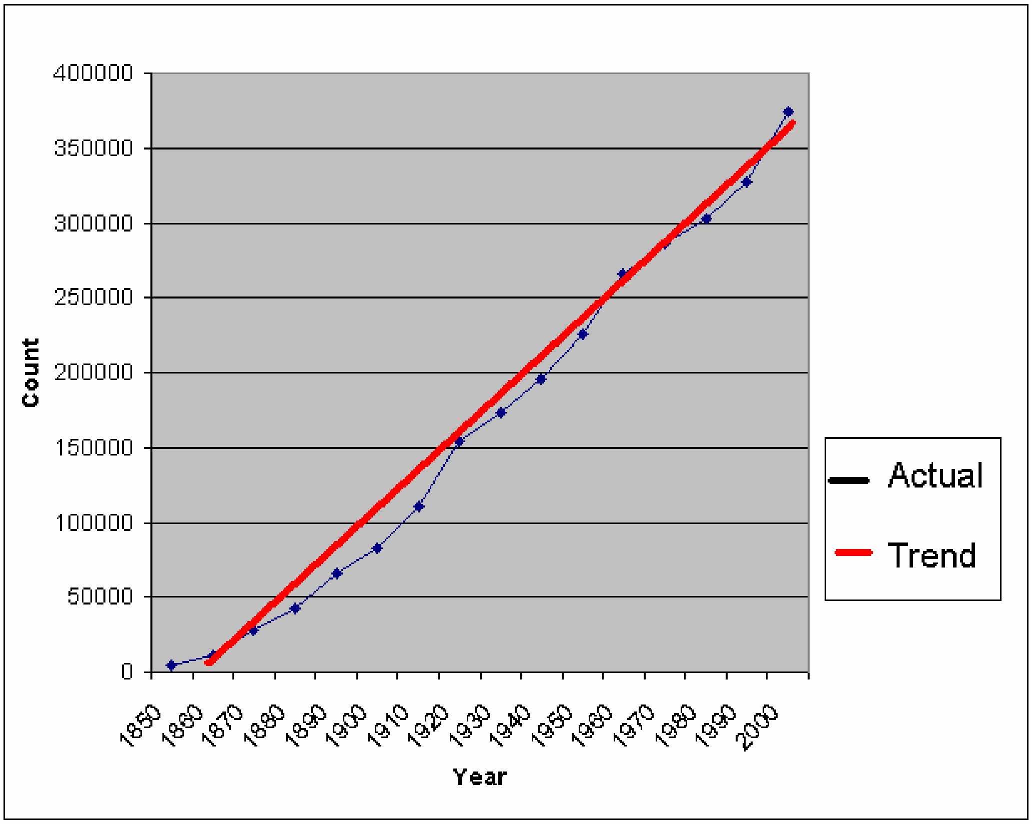
From 1890 to 2000, the population for the county has steadily increased, with a high of 37,213 persons in 2000. Figure B.2 shows the population for Jasper County from 1850 to 2000.



Source: U.S. Census Bureau

Figure B.2. Jasper county population, 1850-2000

The population for Polk County has been steadily increasing since the first recorded U.S. Census in 1850. With a total of 4,513 persons in 1850, the county has increased by a total of 370,088 persons, totaling 374,601 people in 2000. Figure B.3 shows the population for Polk County from 1850 to 2000.



Source: U.S. Census Bureau

Figure B.3. Polk county population, 1850-2000

All three cities along the Iowa 163 corridor study area have increased in population from 1990 to 2000. Pleasant Hill's population has increased the most, with a 38.60% increase in population from 1990 to 2000. The latest U.S. Census record indicates that there are over 5,000 persons in Pleasant Hill, which is an increase of 1,419 people from 1990. The large increase is due to the city's close distance from Des Moines, where commuting to Des Moines for work everyday is common. Monroe saw a small increase in population between 1990 and 2000. The population has increased by 3.70% from 1990 to 2000, a total increase of 64 people. Prairie City grew slightly, with an increase in population of 0.81% between 1990 and 2000.

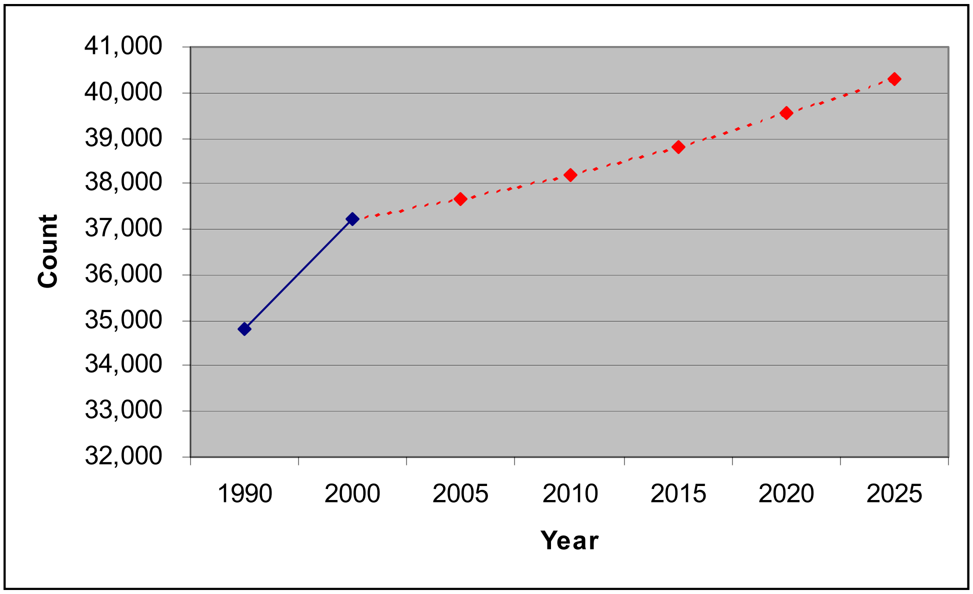
Table B.1. Change in population, 1990-2000

City	1990	2000	% Change 1990-2000
Monroe	1,732	1,796	3.70%
Pleasant Hill	3,676	5,095	38.60%
Prairie City	1,360	1,371	0.81%

Source: Office of Social and Economic Trend Analysis, Iowa State University

County Projections

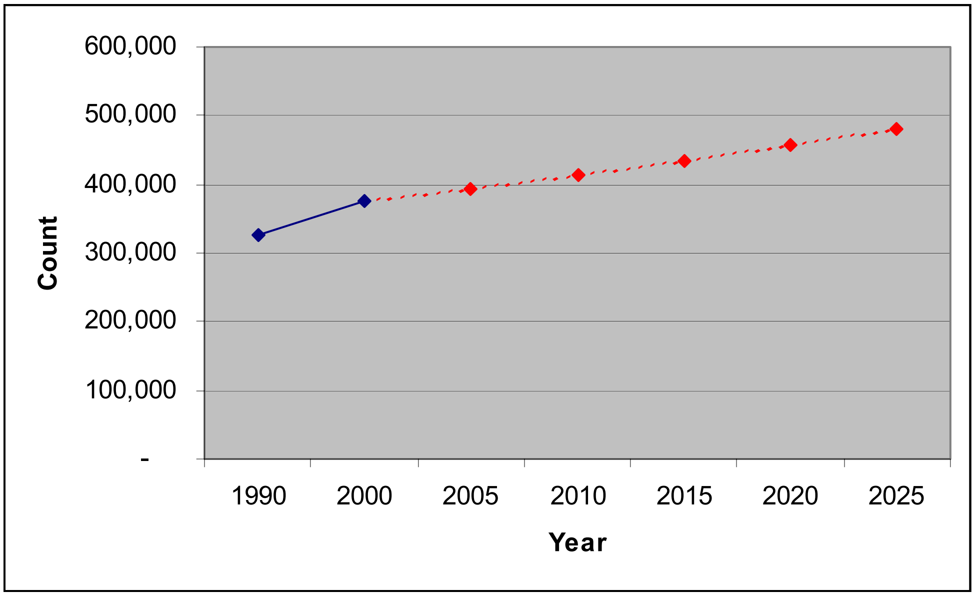
Population projections for this study were obtained by Woods & Poole, Inc. and were prepared in 2002. Jasper County's population is projected to increase steadily from 2000 to 2025. The projected population for 2005 is 37,680 people, which is an increase of 467 persons from the 2000 Census. In 2010, the population is projected to increase to approximately 38,190 persons, in 2015 to approximately 38,820 persons, in 2020 to approximately 39,530 persons, and to roughly 40,000 persons in 2025. Figure B.4 shows the population projections for Jasper County.



Source: Woods & Poole, 2002

Figure B.4. Jasper county population projections

Polk County's population is also projected to increase steadily from 2000 to 2025. The projected population for 2005 is 394,610 people, which is an increase of 20,009 persons from the 2000 Census. In 2010, the population is projected to increase to approximately 414,290 persons, in 2015 to approximately 435,190 persons, in 2020 to approximately 457,050 persons, and to nearly 480,000 persons in 2025. Figure B.5 shows the population projections for Polk County.



Source: Woods & Poole, 2002

Figure B.5. Polk county population projection

Table B.2 shows population projections for Jasper and Polk Counties. As illustrated above, both counties are projected to increase at steady rates. As the table shows, if Jasper County reaches the projected population of 40,280 persons in 2025, that would be an increase of 8.24% from the 2000 population. Likewise, if Polk County reaches the projection of 479,970 persons in 2025, that would be an increase of 28.13% from the 2000 population. The projections are to be used only for guidance to plan for the future needs of the study and not expected to be completely accurate.

Table B.2. Jasper and Polk county population projections

County	2000	2005	2010	2015	2020	2025	% Change 1990-2025
Jasper	37,213	37,680	38,190	38,820	39,530	40,280	8.24%
Polk	374,601	394,610	414,290	435,190	457,050	479,970	28.13%

Source: Woods & Poole, 2002

As Table B.3 indicates, the number of commuters into Jasper County has increased since 1990. The 1990 U.S. Census indicated that 13,624 persons commuted into the county for work, which made up 11% of the total workers in the county. Approximately 17% of the total workers in Jasper County commute into the county according to the 2000 U.S. Census. That is a total of 14,409 persons who commute into the county.

The number of commuters into Polk County has increased since 1990, as shown in the table below. The 1990 U.S. Census indicated that 203,482 persons commuted into the county for work, which made up 18 percent of the total workers in the county. Approximately 20 percent of the total workers in Polk County commute into the county according to the 2000 U.S. Census, which is a total of 234,066 persons who commute into the county daily. The majority of the Polk County commuter origin is in Warren County, Dallas County, Story County, and Jasper County. Approximately 6% of resident workers commute outside of Polk County for work. See Table B.3 below.

Table B.3. Polk county commuting

	1990	2000
Total workers in Polk County	203,482	234,066
Live and work in Polk Co.	167,732	186,471
Live elsewhere and work in Polk Co.	35,750	47,595
% workforce commuting in	18%	20%
Live in Polk Co. and work elsewhere	5,621	11,712
% resident workers commuting out	3%	6%

Source: U.S. Census Bureau

The number of commuters into Jasper County is much lower when compared to Polk County. The 2000 U.S. Census indicates a total of 15,409 workers in the county. Of the 15,409 workers, 12,762 live and work in Jasper County, where only 2,647 live elsewhere and work in the county. There are approximately 5,614 persons who live in Jasper County and work elsewhere. See Table B.4 below.

Table B.4. Jasper county commuting

	1990	2000
Total workers in Jasper County	13,624	15,409
Live and work in Jasper Co.	12,133	12,762
Live elsewhere and work in Jasper Co.	1,491	2,647
% workforce commuting in	11%	17%
Live in Jasper Co. and work elsewhere	4,466	5,614
% resident workers commuting out	27%	31%

Source: U.S. Census Bureau

Current Land Use

Located in the urban setting of Pleasant Hill, Segment One has more of a land use mix compared to Segments Two and Three. The current land use along Segment One of the study area is dominated by commercial and residential use. Commercial use is dominant in terms of location and access to Iowa 163. Segment One has the highest average annual daily traffic (AADT) of all the study corridors due to its urban location and close proximity to Des Moines.

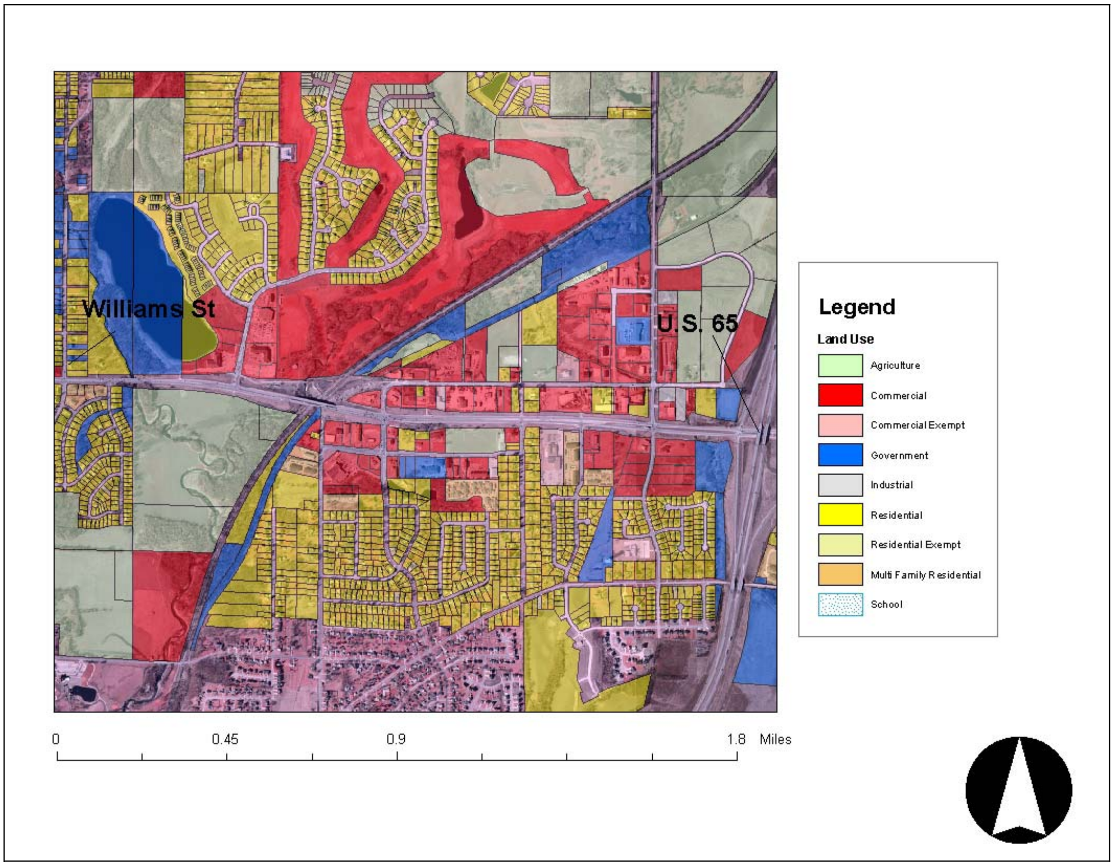


Figure B.6. Current land use, Segment One (Williams Street to U.S. 65)

Segment Two, being the suburban segment of the study area, is a transition from the urban area of Pleasant Hill to the rural portions of Polk and Jasper County. The western portion of the segment located in Polk County (west of the city limits of Pleasant Hill) is predominantly agricultural and residential land use. Southeast Polk High School is located south of Iowa 163 just east of North East 80th Street, as shown in Figure B.7 below. According to the Iowa Department of Education, the latest recorded enrollment for this school was 4,516 students in the 2000-2001 school year. This large school enrollment generates many trips daily along Segment Two.

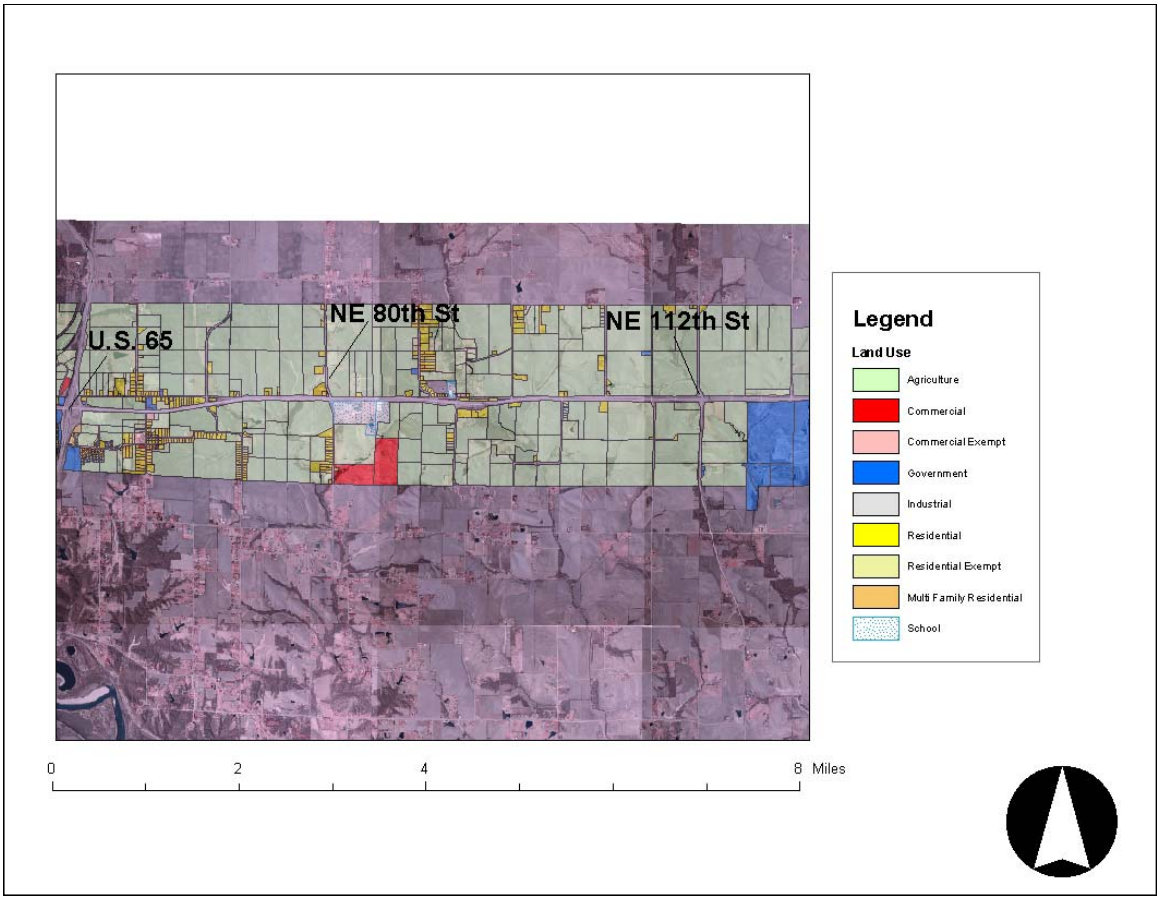


Figure B.7. Current land use, Segment Two (U.S. 65 to NE 112th Street)

The land use along Segment Two in Jasper County, from NE 112th St to Prairie City, is primarily agricultural. A few commercial parcels and government use parcels (Des Moines Metropolitan Area Solid Waste Agency) exist along this portion of the segment. This portion of Segment Two is a transition from suburban to rural in the study. See Figure B.8 for a map of this portion of Segment Two.

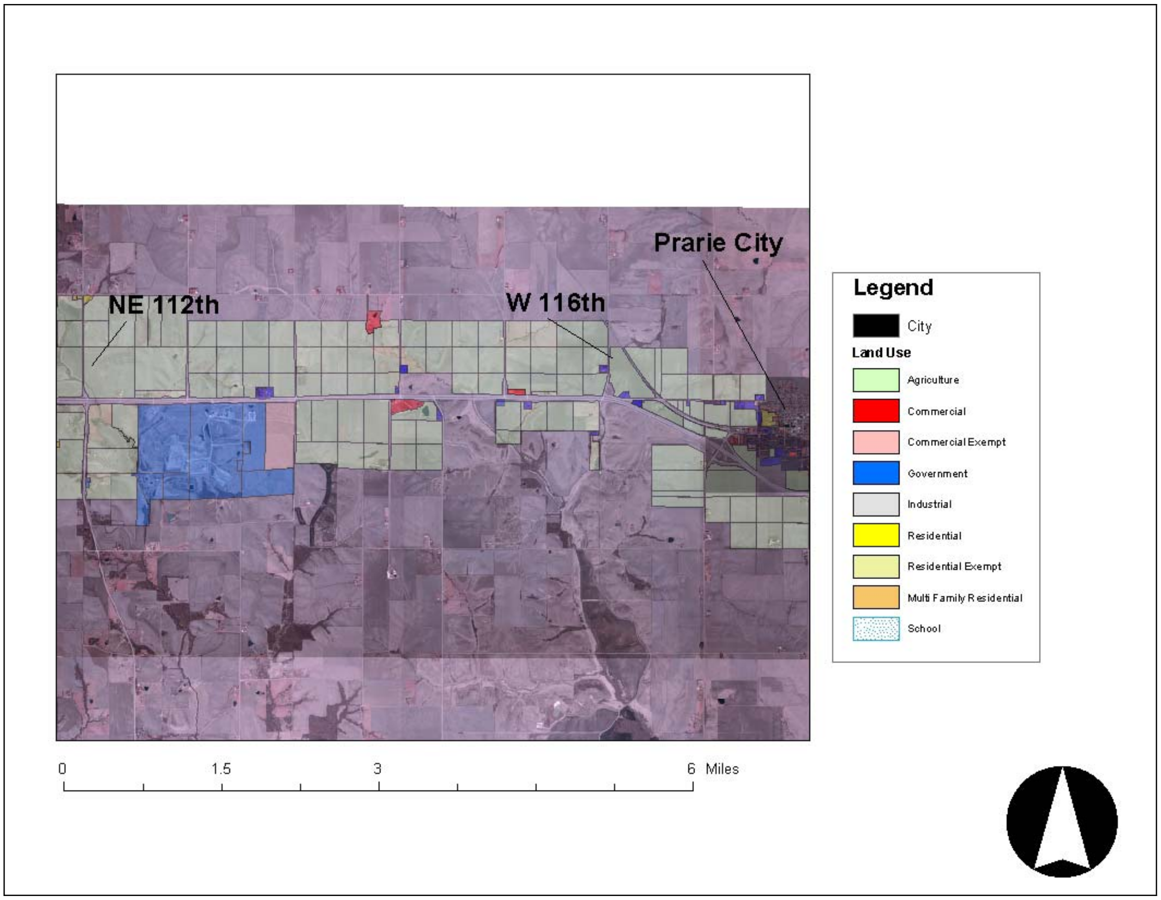


Figure B.8. Current land use, Segment Two (NE 112th Street to West 116th Street)

Segment Three extends from Prairie City to Monroe, and comprises the rural portion of the study area in Jasper County. Accordingly, as shown in Figure B.9, agricultural land dominates this portion of the study area. There is a residential parcel of land approximately one mile east of Prairie City and one approximately two and a half miles to the west of Monroe. Currently, there is no commercial development with direct access to Iowa 163, but as the land use shows there are a few commercial parcels near Prairie City and Monroe.

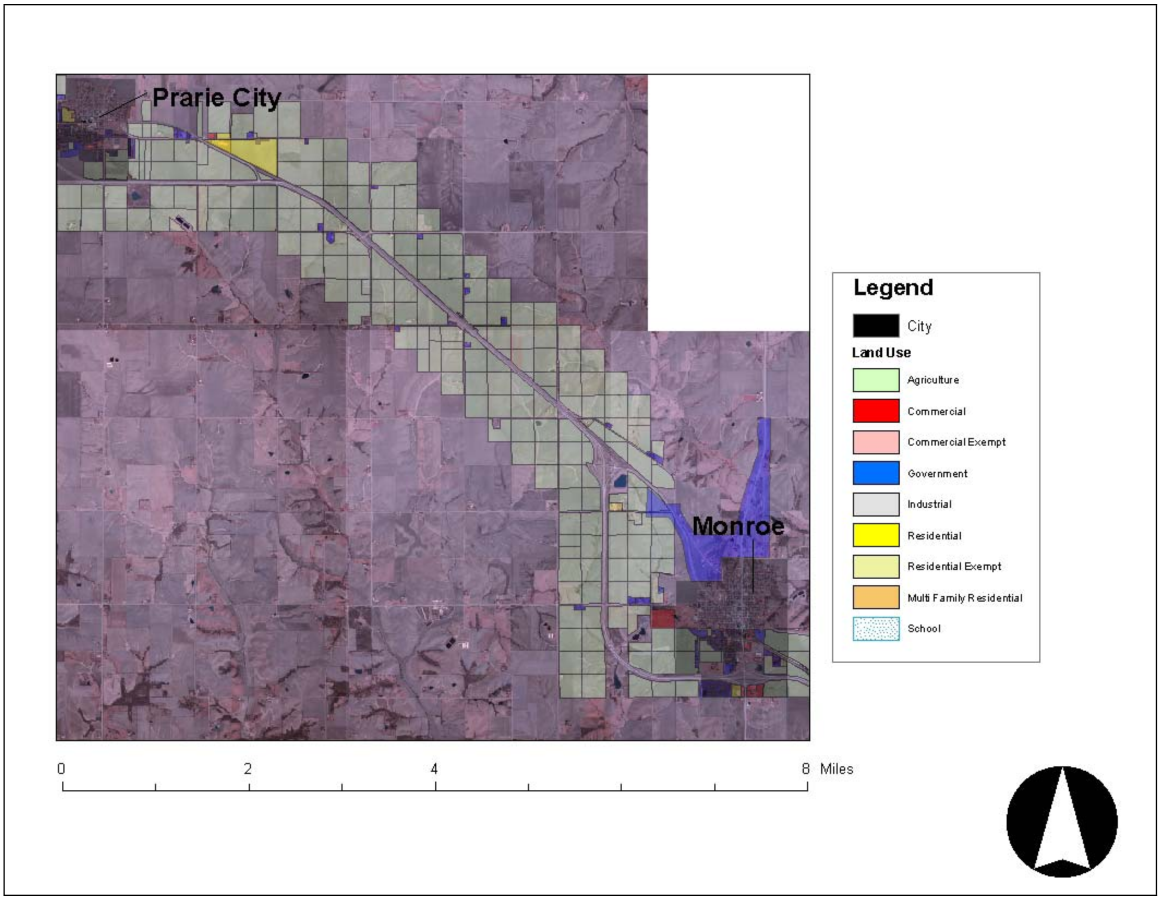


Figure B.9. Current land use, Segment Three (Prairie City to Monroe)

Future Land Use

Future land use data was obtained for Polk County but was not available for Jasper County. However, Jasper County is far more rural than Polk and is expected to remain largely agricultural except in the immediate vicinity of the City of Monroe.

Figure B.10 shows the future land use along Segment One of the study area. From Williams Street to Hickory Boulevard, there is primarily single-family residential land use. Commercial use spans west of Hickory Boulevard along Segment One and into Segment Two of the study area. This commercial use along Segment One spans approximately one mile from Hickory Boulevard to U.S. 65. There is a mix of local commercial and community commercial uses as shown in the figure below. The commercial use extends beyond Segment One and into Segment Two.

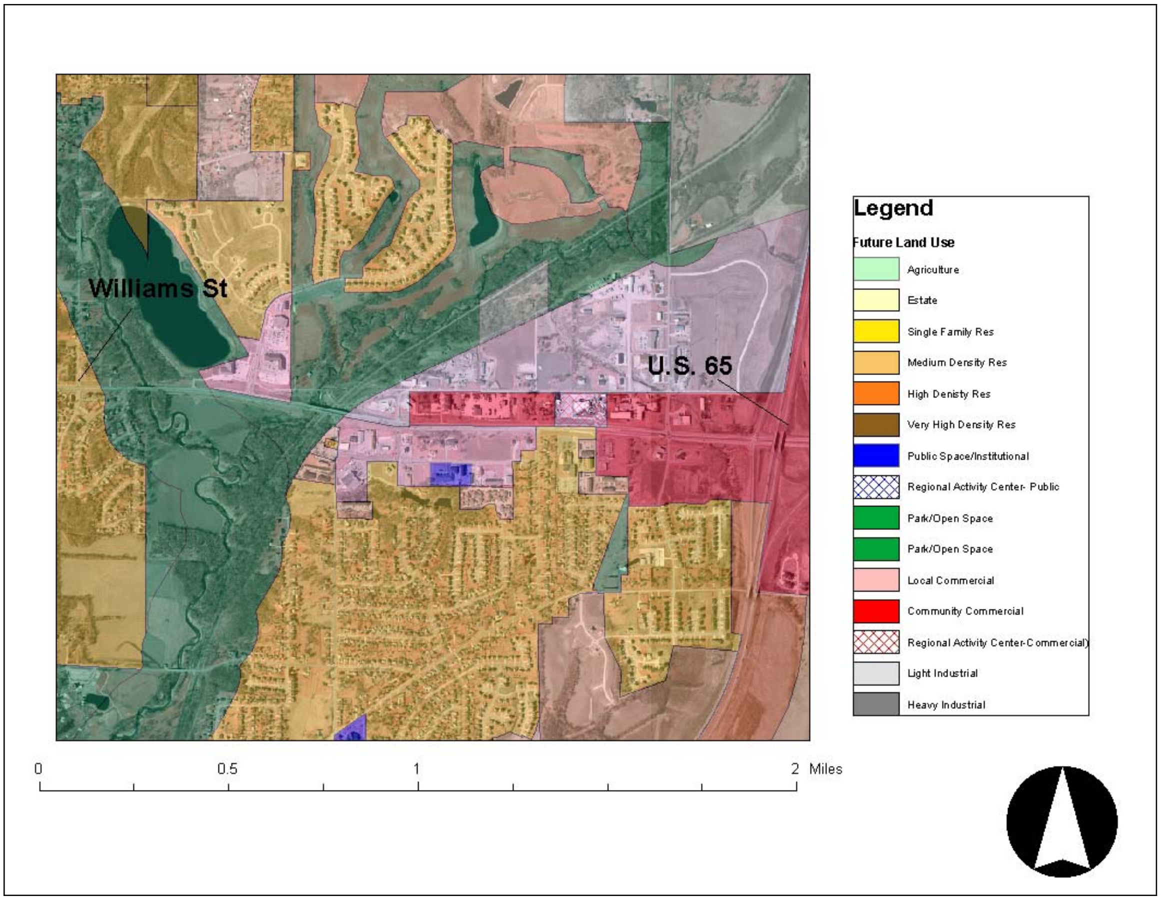


Figure B.10. Future land use, Segment Two (Williams Street to U.S. 65)

The most notable change indicated in the future land use along Segment Two is the expansion of commercial use approximately 1.6 miles east of U.S. 65 to Northeast 70th Street. The future land use also indicates additional residential use to the south of Iowa 163, in the same area where there is planned commercial growth. Southeast Polk High School is approximately one mile to the east of the future commercial growth. As indicated in the future land use, agricultural land use is designated predominately to the east of Southeast Polk High School.

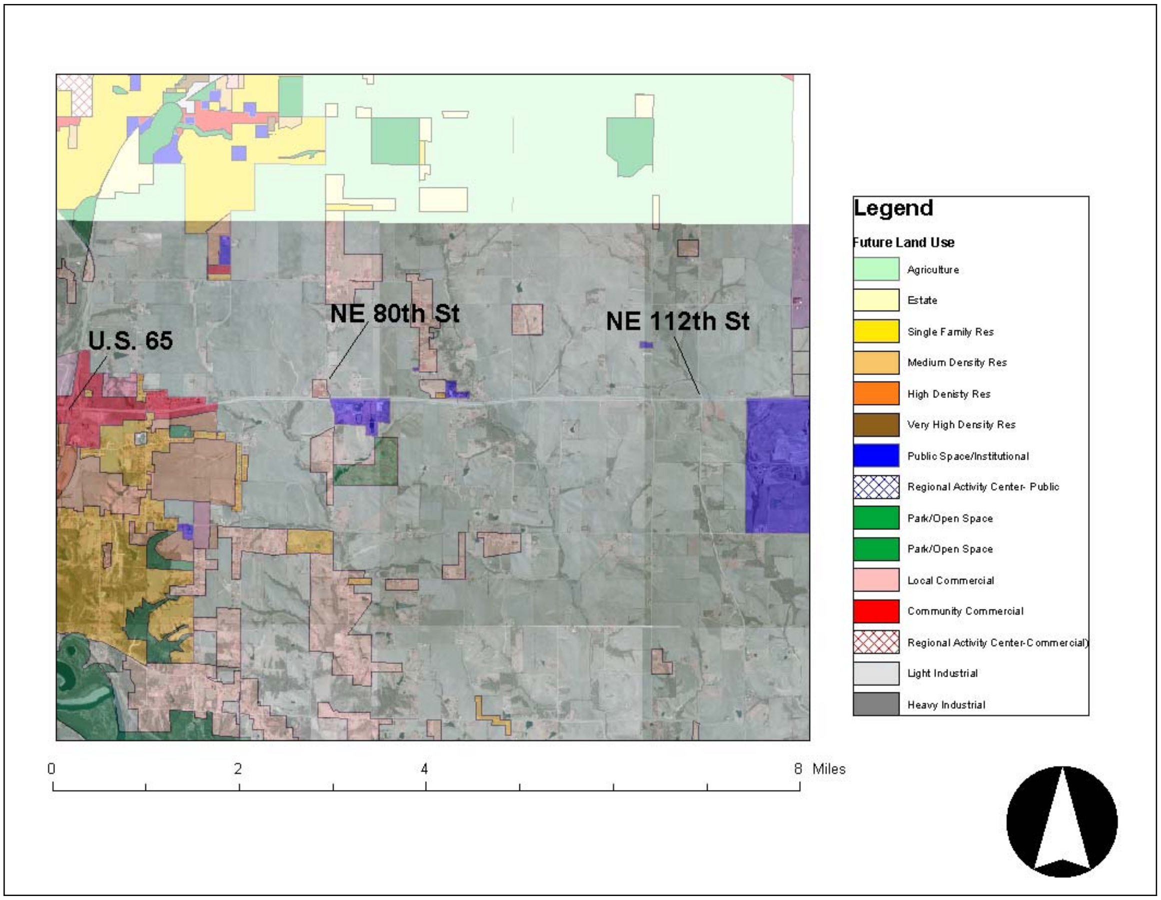


Figure B.11. Future land use, Segment Two (U.S. 65 to Jasper county)

Driveway Density

Driveway density indicates how many driveways per mile are located along each corridor. Driveway density was calculated per segment for the Iowa 163 corridor study area. The driveway density along Segments One and Two are rather low. The driveway density is 2.17 driveways per mile for Segment One and 1.81 driveways per mile for Segment Two. Segment Two had the highest driveway count, with a total of 27 driveways. When comparing Segment One and Two, Segment One has only four driveways, but a slightly higher driveway density than Segment Two due to the short length of Segment One. Table B.5 shows the driveway counts, density, and a qualitative assessment for each Segment.

Table B.5. Driveway density per segment

Segment	Driveways	Segment Length	Driveway Density	Qualitative Assessment
1	4	1.84	2.17	Low
2	23	12.72	1.81	Low
3	0	10.71	0	Negligible

There are four driveways along the 1.84 mile strip of Segment One, and the driveway density for Segment One is 2.17 driveways per mile. There are 23 driveways along

Segment Two, with a driveway density of 1.81 driveways per mile. Although there are more actual driveways along Segment Two compared to Segment One, the driveway density is slightly higher for Segment One because of its short length compared to Segment Two.

Figure B.12 shows driveway locations along Segment One. The driveway density of 2.17 driveways per mile is currently not a pressing issue along the segment. However, it should be noted that if further driveways develop along this segment, an increase in the number of accidents would be likely. Ideally, a rural arterial roadway should have a driveway density of ten or less, or it is more susceptible to accidents. The driveway densities for this study are currently not a large issue. However, it should be stressed that driveway densities could become a pressing issue as development progresses with the majority of these driveways providing access to commercial use.

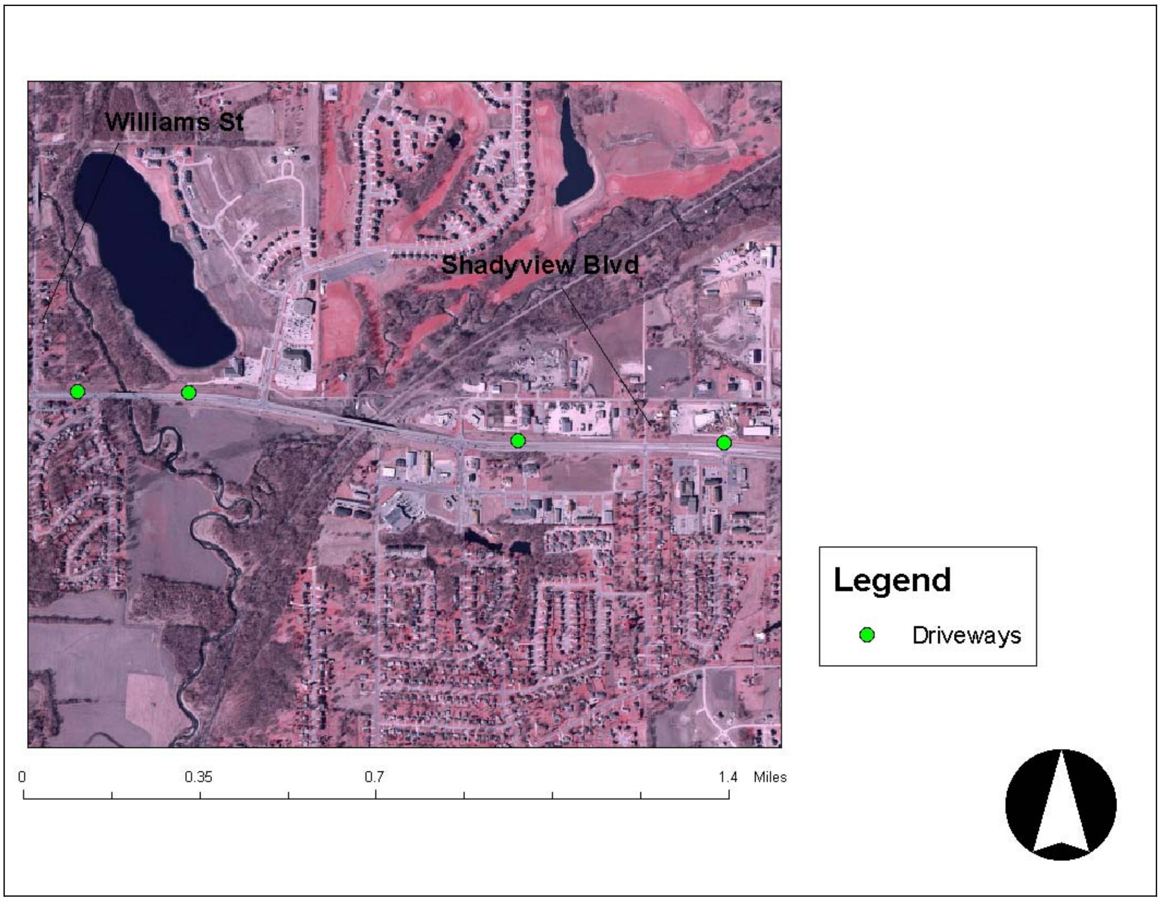


Figure B.12. Driveway locations, Segment One

Figures B.13 and B.14 show driveway locations along Segment Two. As noted before, the driveway count is 23 driveways with a density of 1.81 driveways per mile. Currently, this is a low density. However, if commercial development grows along this Segment, it could become an issue. Of the existing driveways along Segment Two, the majority of them provide access to residential parcels.

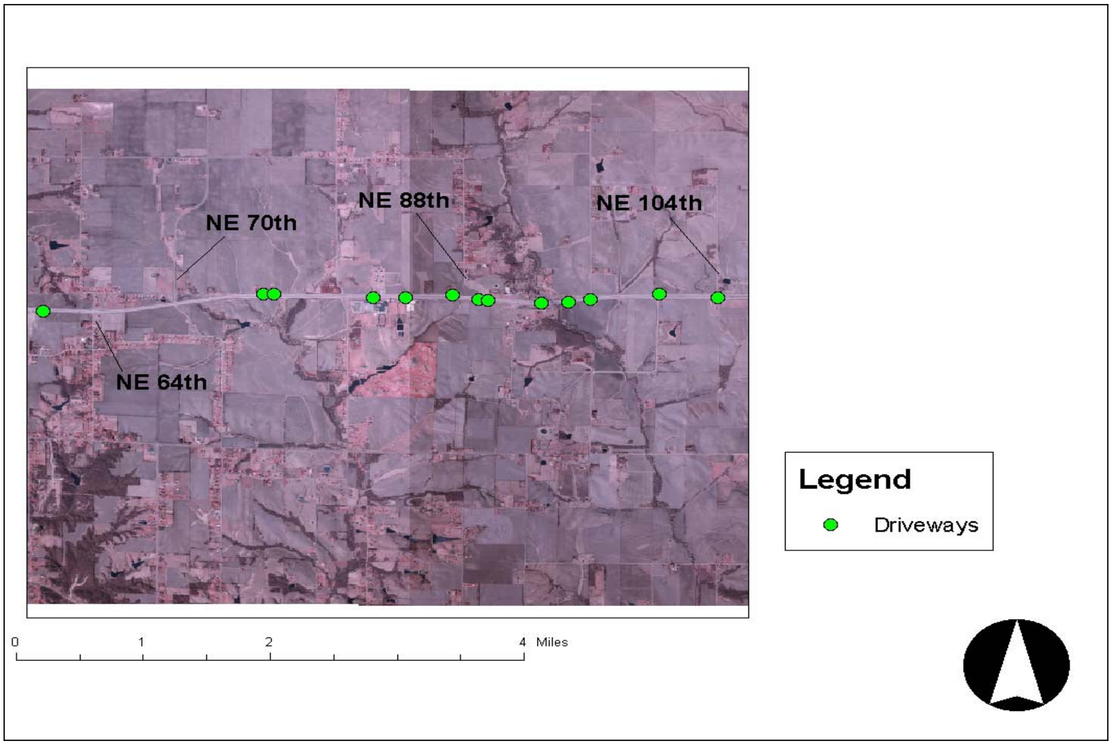


Figure B.13. Driveway locations, Segment Two (NE 84th Street to NE 104th Street)

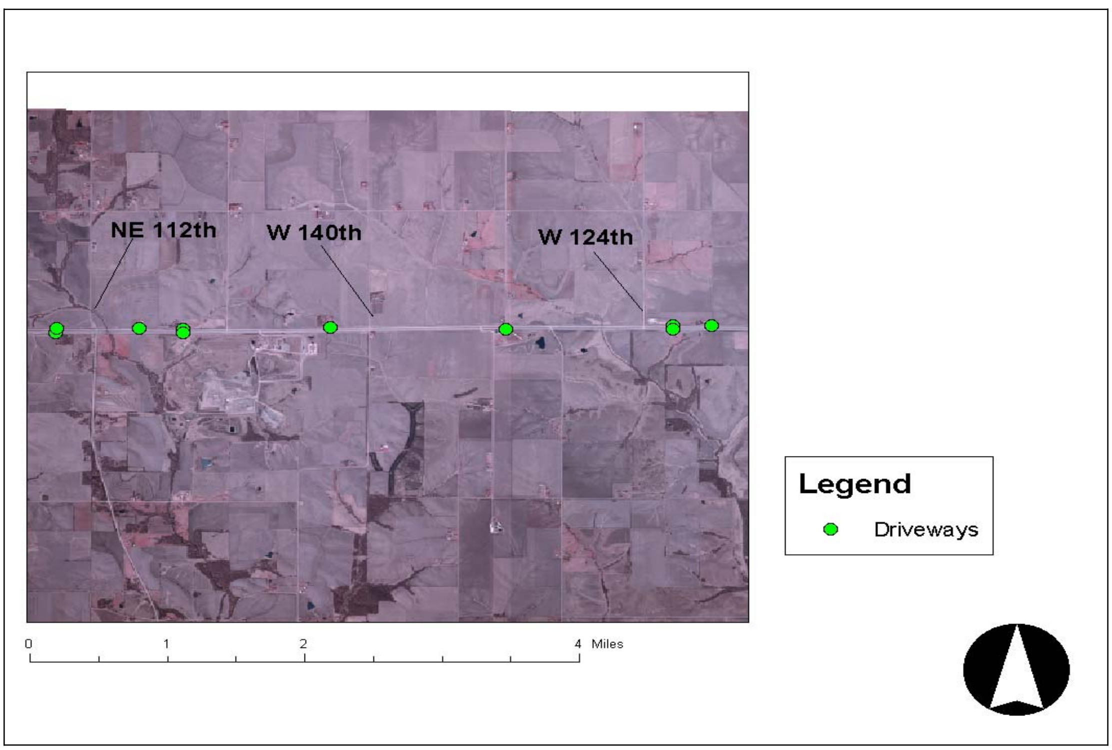


Figure B.14. Driveway locations, Segment Two (NE 112th Street to West 124th Street)

Figure B.15 shows driveway locations and signalized intersections along Segment One and a portion of Segment Two. As the figure shows, there is no abundance of driveways or traffic signals, and the majority of these signals are along Segment One. Segment One, from Williams Street to U.S. 65, has multiple driveways and traffic signals within close proximity, with a few signals spaced less than a half-mile apart. The majority of the accidents occurring along Segment One are rear-end collisions, which could be explained by the presence of signals and access points such as public road intersections and driveways. (It should be noted that additional traffic signals have recently been placed at the ramp terminals at the interchange between U.S 65 and IA 163; it is too soon to evaluate the safety impacts of these signals.)

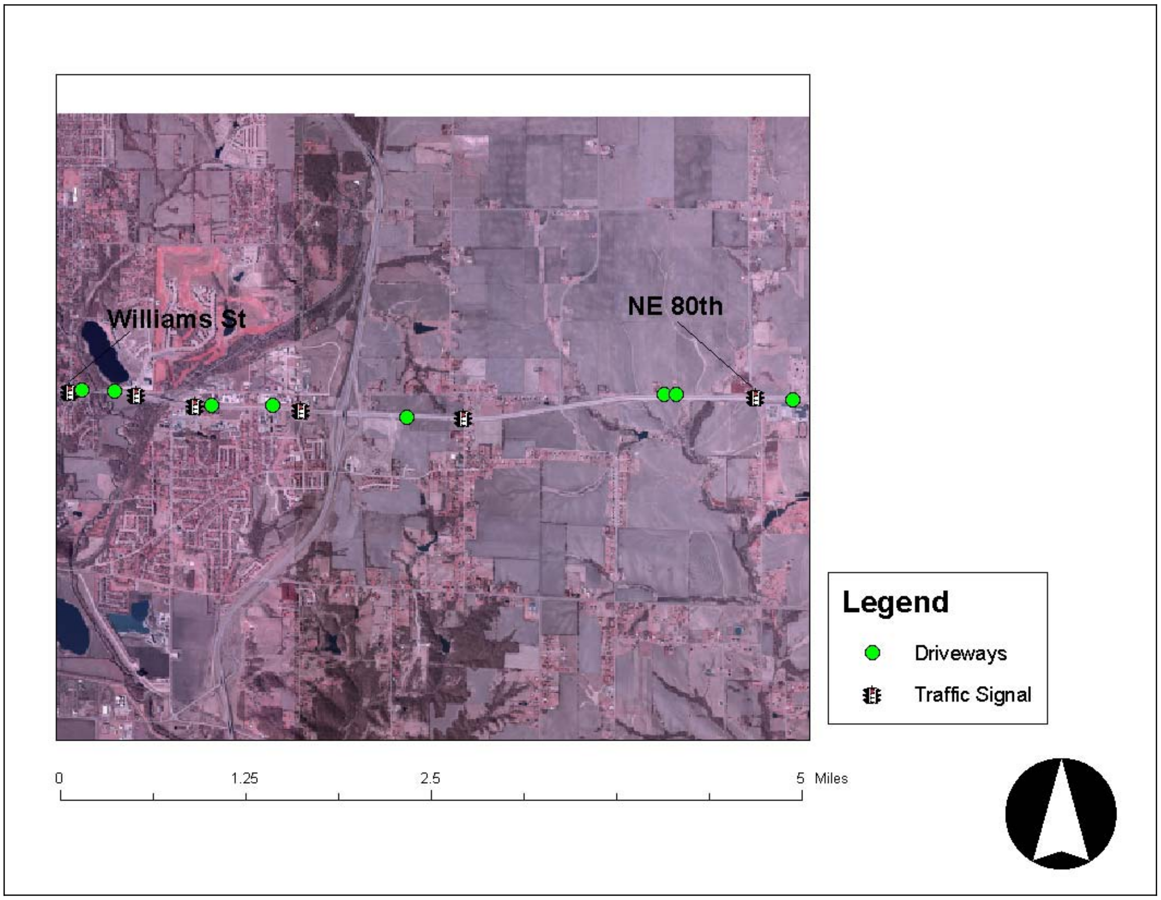


Figure B.15. Driveway and traffic signal locations, Segment One (and a small portion of Segment Two)

Driveway Locations and Land Use

As mentioned above, the majority of the driveway locations are along Segment One and Segment Two of the study area, with Segment One having the highest driveway density of the two. Both current and future land uses show that commercial and residential land uses dominate this portion of Iowa 163. The future land use indicates that commercial growth is anticipated further east along this segment. When comparing the current and future land uses, there is an abundance of additional commercial land use along Segment

One, from Hickory Boulevard to U.S. 65. It is likely that with additional commercial development, the number of driveways along Iowa 163 could increase.

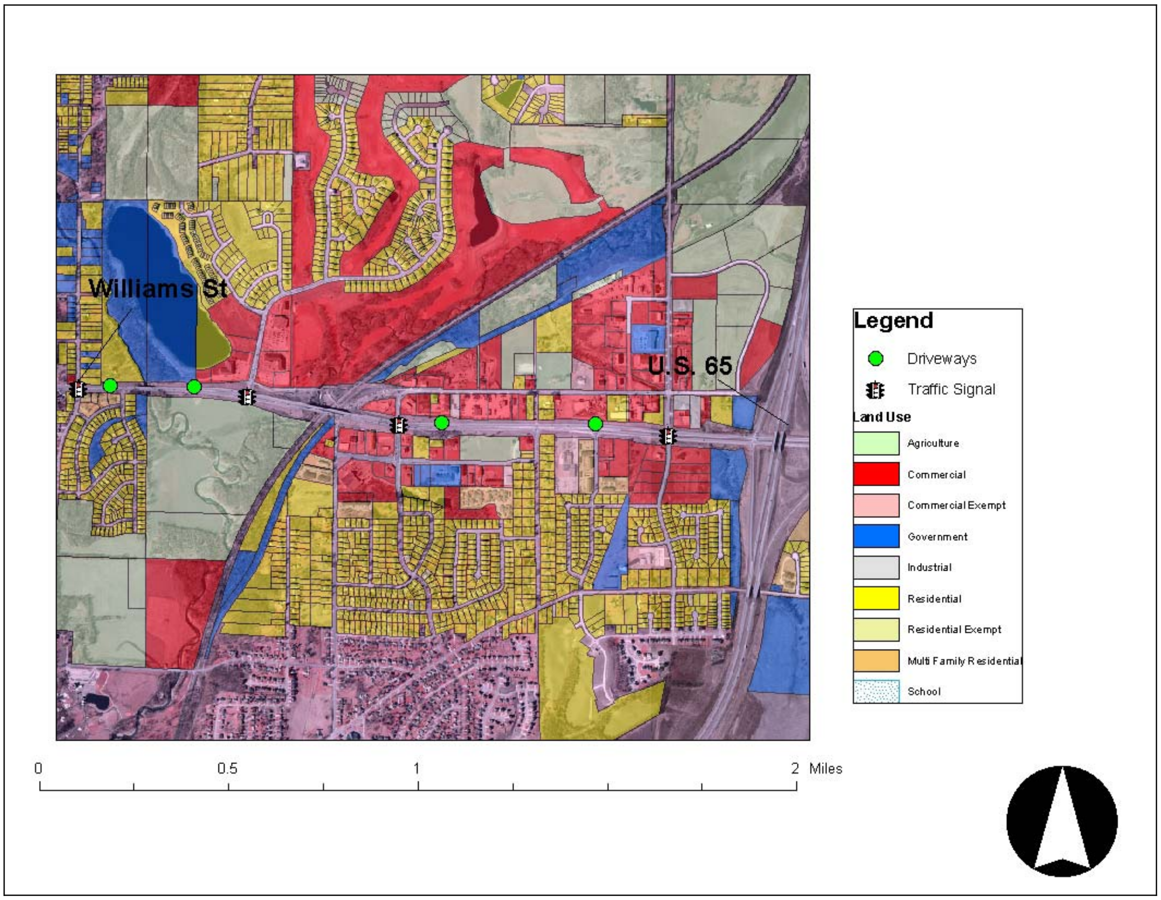


Figure B.16. Current land use and driveway locations, Segment One (Williams Street to U.S. 65)

The future land use for Polk County along Segment Two (from U.S. 65 to West 148th Street) does not change dramatically from the current land use, with the exception of commercial uses near U.S. 65. Commercial growth is planned to extend from U.S. 65 to Northeast 70th Street, which is approximately 1.6 miles of additional commercial use along Iowa 163. The additional commercial land use will likely have an impact on the traffic volume and flow along Iowa 163. Some results of the land use change could include additional driveways, traffic signals, and possibly increased access-related crashes.

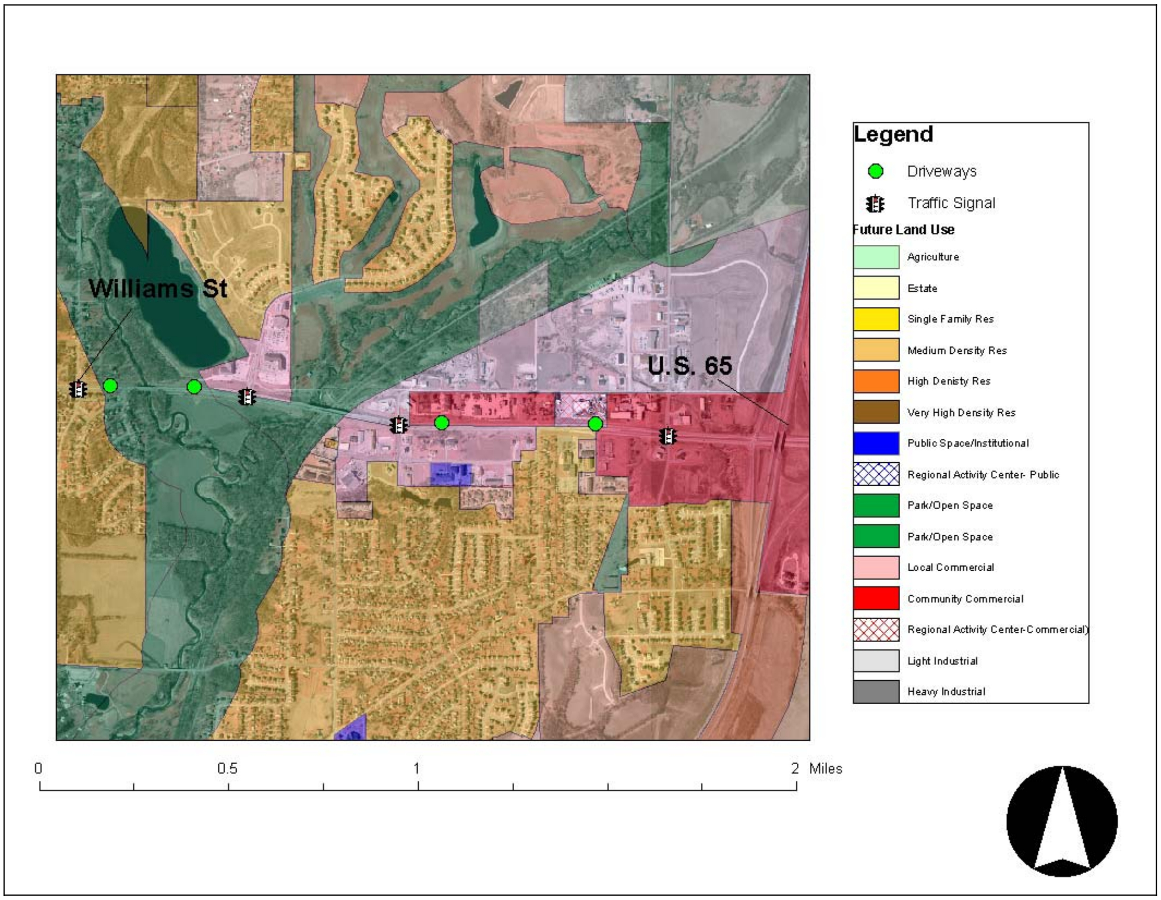


Figure B.17. Future land use and existing driveway locations, Segment One (Williams Street to U.S. 65)

Figures B.18 and B.19 compare the current and future land uses for Segment Two. When looking at the two figures, there are no drastic changes in current or future land use, with the exception of the future commercial and residential uses to the east of U.S. 65. There are a few public space or institutional areas in the future land use: one to the northeast of the intersection of Iowa 163 and Northeast 80th Street and the other to the northeast of the intersection of Iowa 163 and Northeast 88th.

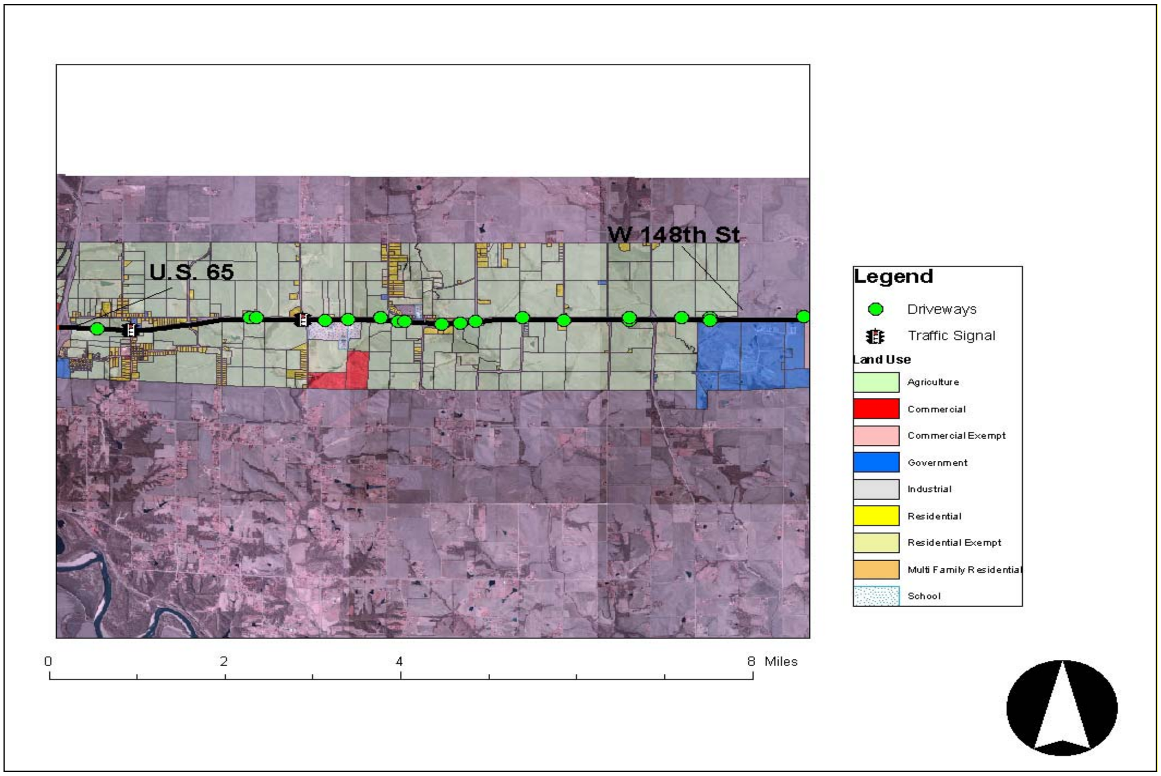


Figure B.18. Current land use and driveway locations, Segment Two (U.S. 65 to Jasper county)

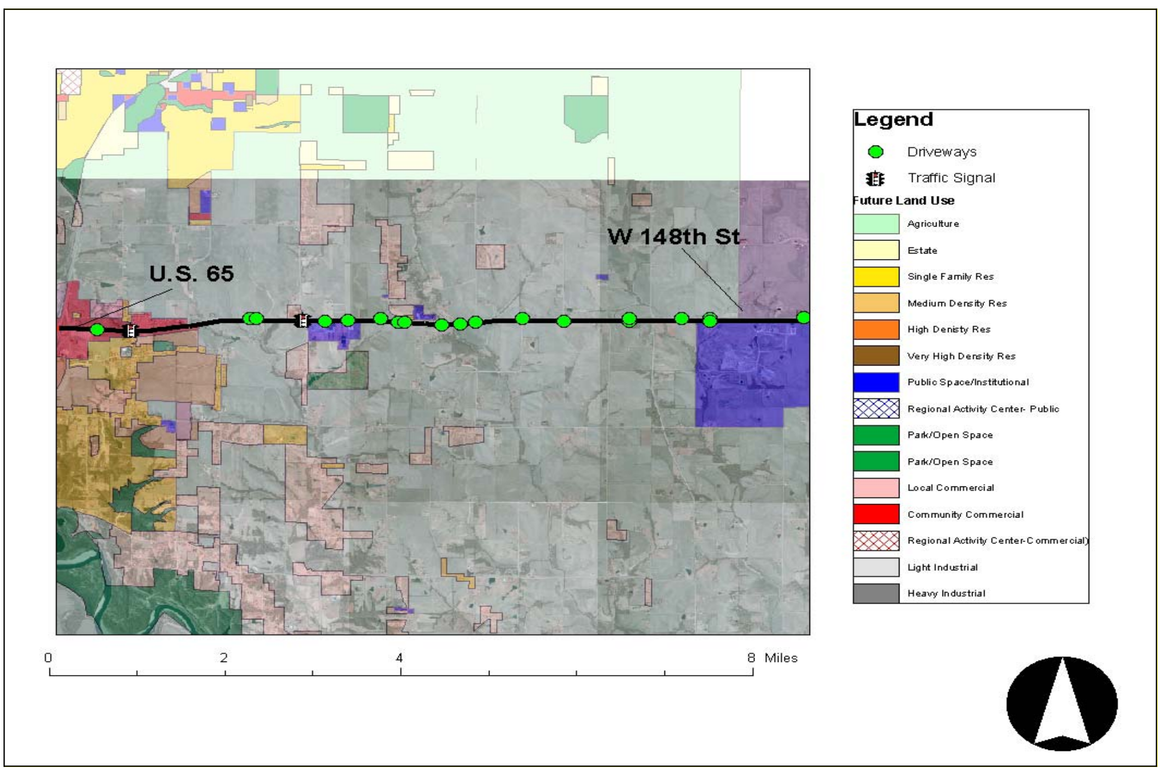


Figure B.19. Future land use and driveway locations, Segment Two (U.S. 65 to Jasper county)

Complete corridor crash statistics

Crash Frequency

By analyzing crashes on all three study segments of Iowa 163 in Jasper and Polk County, one can compare the entire corridor's safety levels with other Iowa roadways. Total crashes on the complete corridor throughout the two counties are an important measure of overall roadway safety, while analyzing possible access-related crashes can be used as a measure of effectiveness of Iowa 163's overall access management. For this study, "total" crashes refer to all crashes occurring on the corridor of interest. These crashes contain all crash types, and their occurrence along the route can mark all types of safety problems, not only access management problems. Conversely, "access-related" crashes are all types of crashes that could relate to access problems, queried out of the total crashes on the corridor. Turning, broadside, and rear-end crashes are typically associated with access problems on roadways. The crash frequencies and rates cited in this study were computed in a geographic information system (GIS).

Table B.6 shows that from 1997 to 2000, there were 243 total crashes on the complete Iowa 163 study corridor through Jasper and Polk County.

Table B.6. Crash frequencies for total and probable access-related crashes per corridor, 1997-2000

	Iowa 163	Segment One	Segment Two	Segment Three
Total Crashes	243	105	123	15
Probable Access-Related Crashes	107	55	49	3
Rear End	58	38	18	2
Left Turn	4	2	2	0
Right Turn	45	15	29	1

Table B.7. Crash frequencies and breakdown of probable access-related crashes, 1997-2000

	Crash Frequency	% of access crashes by type
Total Crashes	243	
Probable Access-Related Crashes	107	
Rear End	58	54.21
Left Turn	4	3.74
Right Turn	45	42.06

The crash analysis yielded 107 probable access-related crashes on the Iowa 163 corridor between 1997 and 2000. Separated by crash type, there were 58 rear-end crashes, representing 54.21% of all access-related crashes; 4 left-turning crashes, representing 3.74% of all access-related crashes; and 45 right-turning crashes, representing 42.06% of all access-related crashes on Iowa 163.

Crash statistics by corridor segments

Crash Frequency

Crash analysis on the entire Iowa 163 corridor is helpful to determine corridor safety problems. However, the corridor has three different concentrations of land uses and driveway densities along the route, which could contribute to tiered levels of crash frequencies and rates found for both total and access-related crashes at different points of the corridor. As stated previously, the Iowa 163 corridor in Jasper and Polk County could be divided into three separate segments based on growth and land development patterns. Generally, the development patterns on these three segments also correspond to total crash frequency patterns on Iowa 163. Segment One, from Williams Street to U.S. 65 in Pleasant Hill, is highly urbanized compared to the rest of Iowa 163 in the county and exhibits a high total crash frequency of 105 total crashes (as seen in Table B.8). Segment Two, from the U.S. 65 to Prairie City, exhibits the highest crash frequency along the study corridor, with 123 total crashes. Segment Three, from Prairie City to Taylor Street in Monroe, remains mostly rural and undeveloped. Its crash frequency is the lowest of the Iowa 163 segments, with only 15 total crashes.

Table B.8. Crash frequencies and percentage of total crashes per segment

	Segment One	% of total crashes	Segment Two	% of total crashes	Segment Three	% of total crashes	Total crashes All segments
Total Crashes	105		123		15		243
Probable Access-Related	55	52.38%	49	39.84%	3	20.00%	107
Rear End	38	36.19%	18	14.63%	2	13.33%	58
Left Turn	2	1.90%	2	1.63%	0	0.00%	4
Right Turn	15	14.29%	29	23.58%	1	6.67%	45

However, the access-related crash frequencies for each segment illustrate possible access problems along Iowa 163 that may be related to how the corridor's land uses and driveway densities have developed. Table B.8 above shows that out of Segment One's 105 total crashes, 55, or 52.38% are access-related. Segment Two has 123 total crashes, with 49, or 39.84% access-related crashes. Segment Three has 15 total crashes, and 3, or 20.00%, are access-related. The progression of access-related crash frequencies from urbanized to rural areas shows that urbanized areas on Iowa 163 experience far more access-related crashes than do the rural areas of the corridor.

Categorizing access-related crashes into their individual crash types provides insight into crash causes. A profusion of a certain crash type on one segment can highlight specific access problems on the roadway. According to Table B.8 above, Segment One had 55 access-related crashes, with 38 rear-end crashes, 2 left-turning crashes, and 15 right-turning crashes. Rear-end crashes constitute 69.09% of all access-related crashes on Segment One, and these rear-end crashes are clustered together in small groups, mainly around the public road intersections, traffic signals, and driveways. The clustering of crashes could indicate a possible roadway or driveway problem in those locations. In addition, the crash pattern could be related to the high density of signalized intersections on Segment One. Segment Two has 49 access-related crashes, 18 of which are rear-end crashes, 2 left-turning crashes, and 29 right-turning crashes. Segment Three has 3 access-related crashes, with 2 rear-end crashes, 0 left-turning crashes, and 1 right-turning crash.

Table B.9. Breakdown of access-related crashes by segment

	Segment One	% of access crashes	Segment Two	% of access crashes	Segment Three	% of access crashes
Access-Related Crashes	55		49		3	
Rear End	38	69.09%	18	36.73%	2	66.67%
Left Turn	2	3.64%	2	4.08%	0	0.00%
Right Turn	15	27.27%	29	59.18%	1	33.33%

The locations of many probable access-related crashes on the Iowa 163 corridor do coincide with major intersections in urbanized areas. This trend is most apparent on Segments One and portions of Segment Two, the most urbanized segments of the Iowa 163 corridor. For instance, Figure B.20 shows the location of probable access-related crashes near Copper Creek Road, which is contained within Segment One. Copper Creek Road is a signalized intersection, and Figure B.20 also shows that the majority of these probable access-related crashes are rear-end crashes. The high instance of rear-end crashes could be related to the signalization, for traffic frequently stops at this intersection.

Figure B.20 below shows probable access-related crashes from Williams Street to Copper Creek Road, along Segment One. All of the crashes along this portion of the Segment One are rear-end collisions, with the exception of one left-turn collision at Winegardner Road. Traffic signals located at Williams Street and Copper Creek Road can explain the occurrence of rear-end collisions along this portion of the segment.

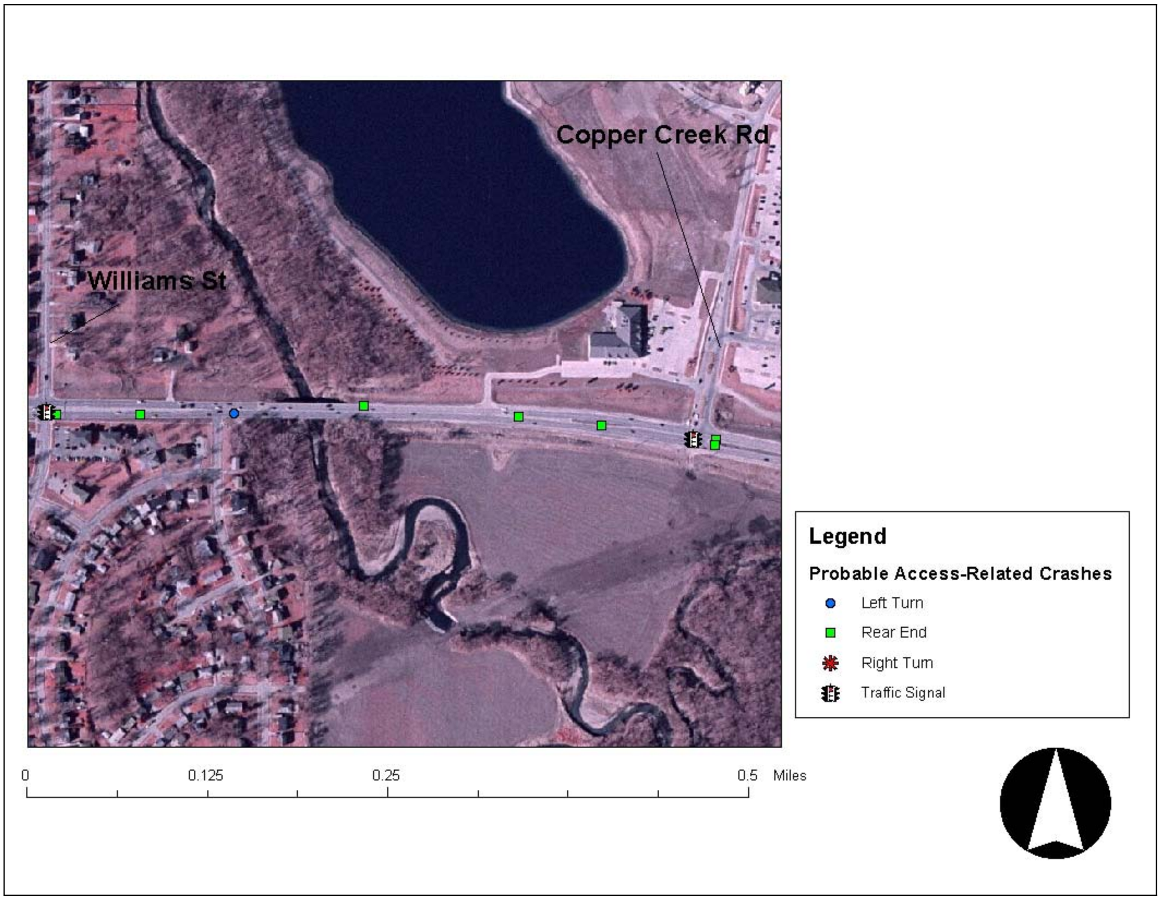


Figure B.20. Probable access-related crash locations, Segment One (Williams Street to Copper Creek Road)

As shown in Figure B.21, there is a small cluster of rear-end collisions at the intersection of Iowa 163 and Hickory Boulevard. These rear-end collisions are likely related to the traffic signal here. Figure B.22 shows the same pattern with mainly rear-end collisions and a few right-turn collisions occurring near the intersection at Iowa 163 and NE 56th St.

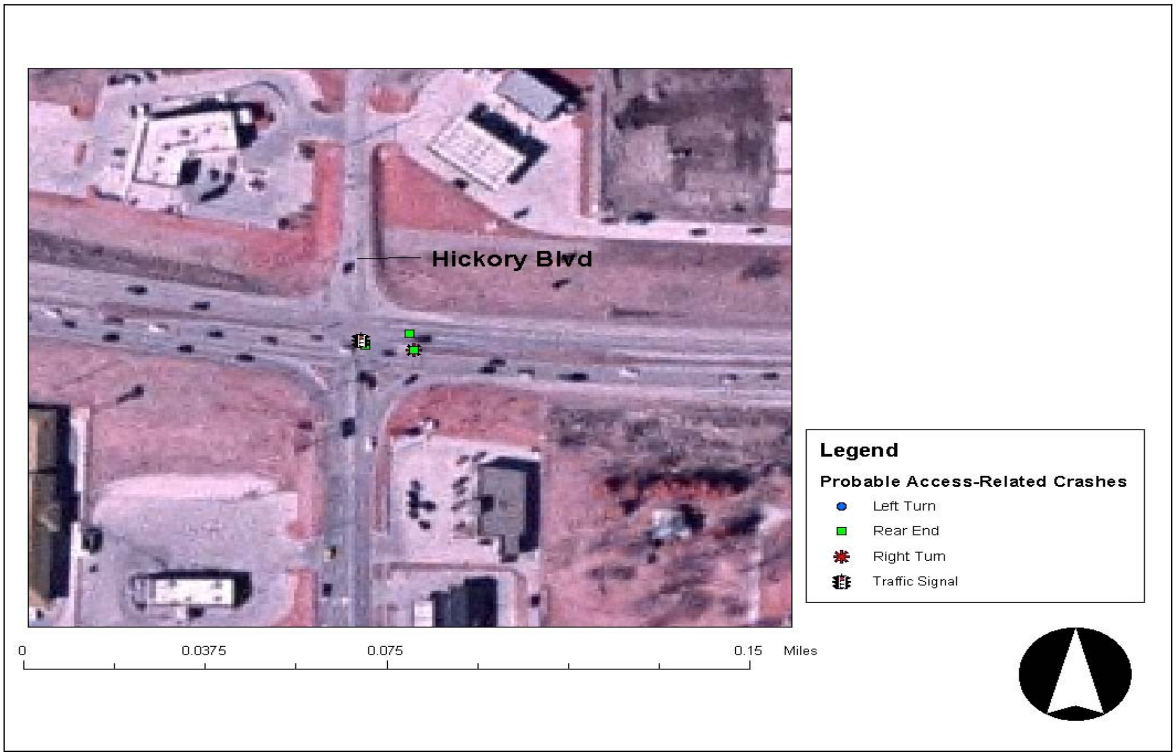


Figure B.21. Probable access-related crash locations on Segment One (Hickory Boulevard)

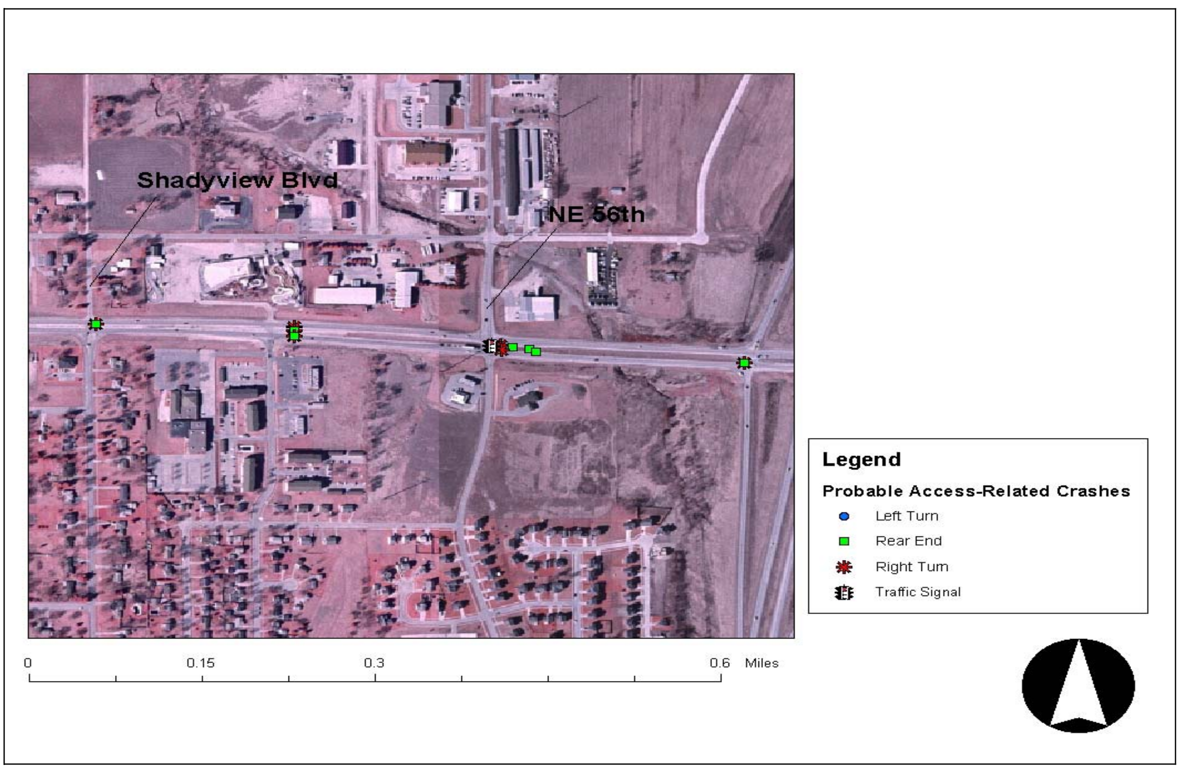


Figure B.22. Probable access-related crash locations on Segment One (Shady View Boulevard to NE 56th Street)

Of the access crashes along Iowa 163, there were a total of 49 access-related crashes along Segment Two from 1997 to 2000. Figure B.23 shows the access-related crashes along Segment Two from U.S. 65 to Northeast 70th Street. There are a few right-turn and rear-end collisions along this portion of the segment. However, they are not all concentrated at the intersection of Northeast 70th Street and Iowa 163, which indicates that the signalized intersection may not be the probable cause of turning crashes here.

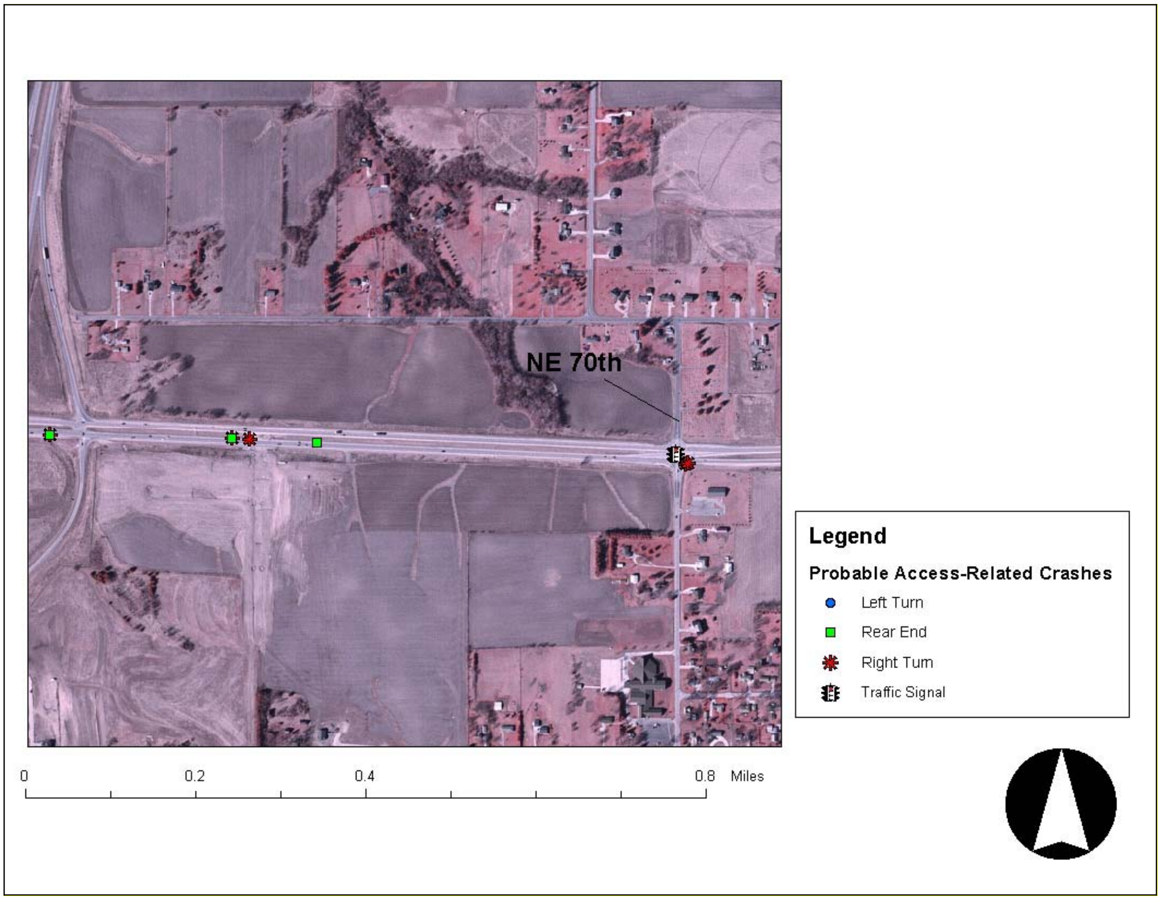


Figure B.23. Probable access-related crash locations, Segment Two (U.S. 65 to NE 70th Street)

Figure B.24 shows the access-related crashes from Northeast 80th Street to Northeast 88th Street along Segment Two. Southeast Polk High School is located to the southeast of Northeast 80th Street and Iowa 163. Right turn crashes are dominant at this intersection, which is of concern due to its proximity to the high school.

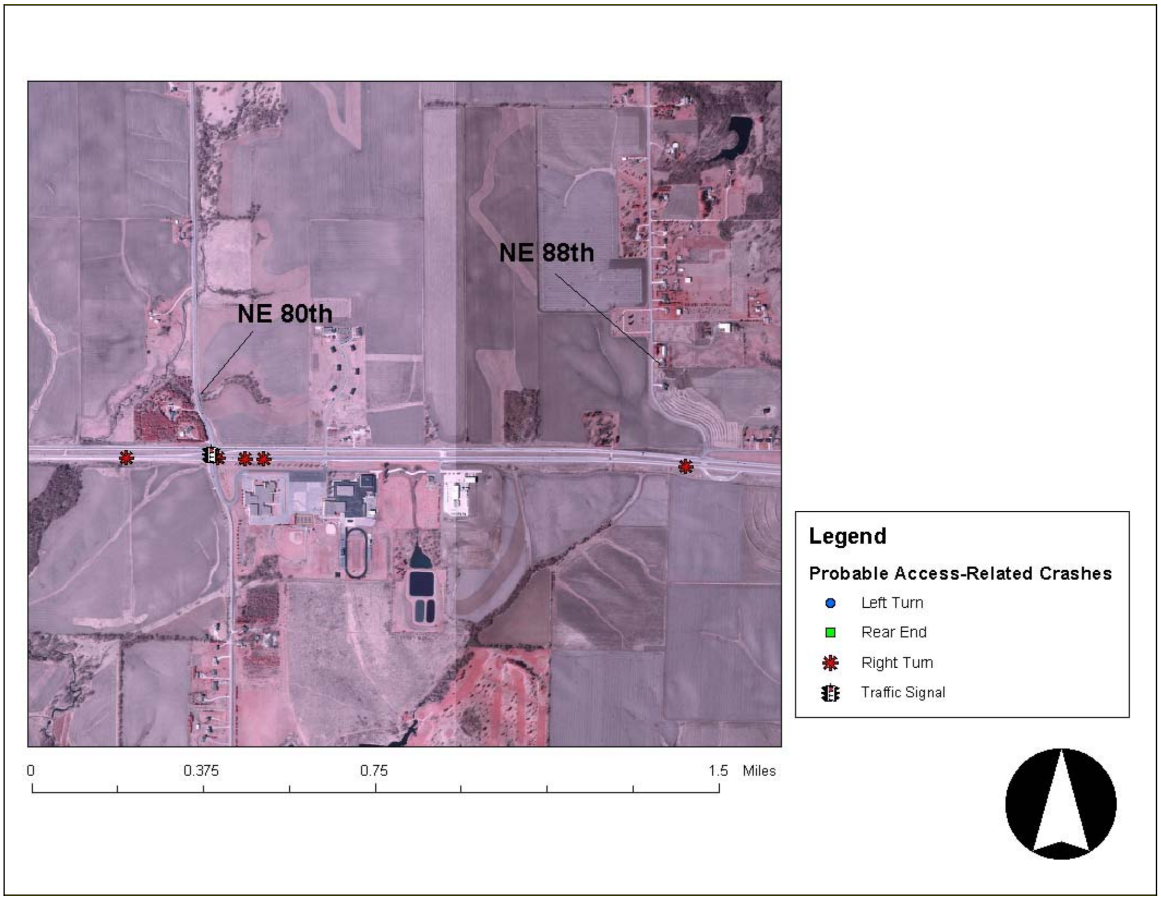


Figure B.24. Probable access-related crash locations, Segment Two (NE 80th Street to NE 88th Street)

From Northeast 96th Street to West 116th Street along Segment Two, the majority of crashes are rear-end crashes. There is one right-turn crash at the intersection of Iowa 163 and West 116th Street. The numerous rear-end crashes can possibly be explained by vehicles not slowing down enough and colliding with turning vehicles ahead of them. Also, this can be a product of poor sight distance. For example if the terrain is hilly, the reduced sight distance restricts the drivers' reaction time to respond to circumstances. As shown in Figure B.25, there are five rear-end collisions along this portion of the segment and one right-turn crash.

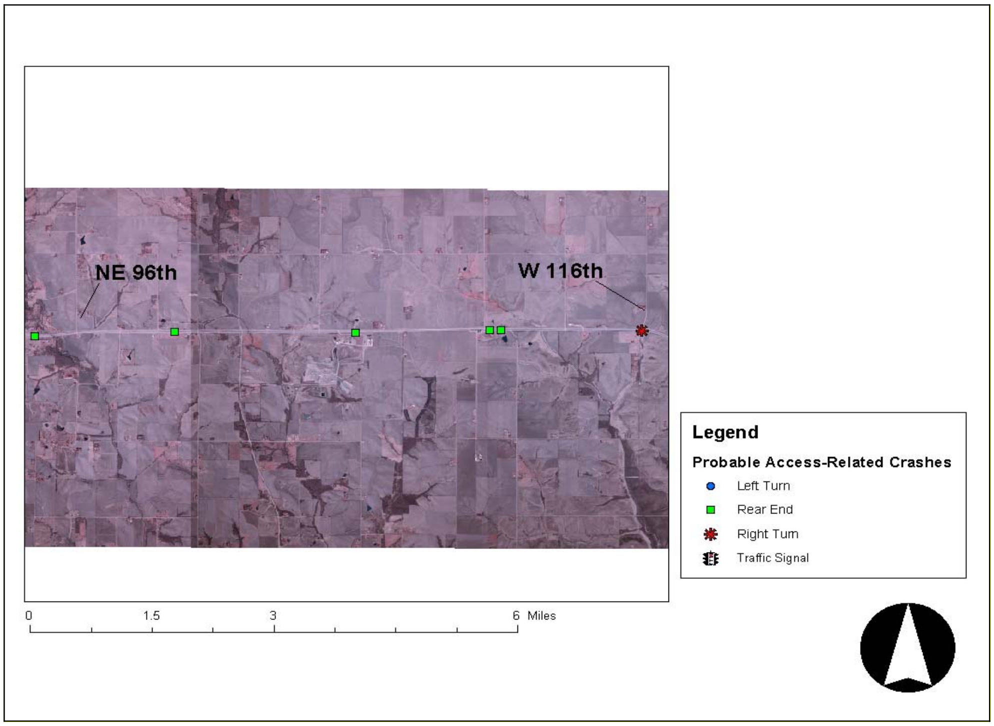


Figure B.25. Probable access-related crash locations, Segment Two (NE 96th Street to West 11th Street)

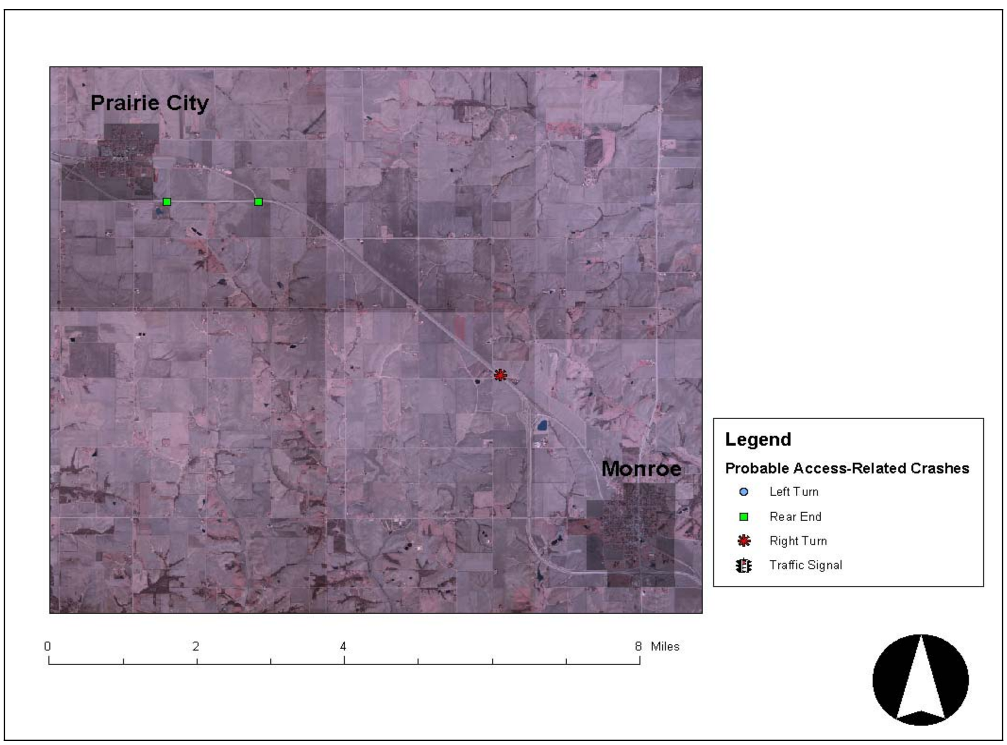


Figure B.26. Probable access-related crash locations, Segment Three (Prairie City to Monroe)

Crash Rates

Crash rates were another tool used to analyze the Iowa 163 corridor by its study segments. To calculate crash rates, vehicle miles traveled (VMT) must be calculated. To calculate VMT, the analysis period (4 years multiplied by 365 days) was multiplied by the length of each individual road section, as well as the average annual daily traffic counts (AADT) weighted by length of the road section. The resulting VMT was calculated for individual road sections, and then VMT was summed for each of the three segments of Iowa 163.

Table B.10. AADT, VMT, and length by segment

	Segment One	Segment Two	Segment Three
AADT	16,296	10,543	6,823
Summed VMT	44,173,030	198,473,568	101,169,824
Corridor Lengths (in miles)	1.84	12.72	10.71

The results of the AADT counts and the VMT calculation, compared to segment length, are seen above in Table B.10. The VMT, when compared to segment lengths, shows the most heavily traveled segments of the Iowa 163 corridor. Segment One has the lowest VMT; however, Segment One is only 1.84 miles in length. This indicates that Segment One, being the urban segment, experiences a high density of traffic.

Crash rates were then calculated using the VMT figures shown previously. To find crash rates, the crash frequency per corridor was first multiplied by one million, then divided by the VMT, and then summed per corridor. The resulting crash rate is the approximate number of crashes that occurred in the four-year time period on the corridor per million vehicle miles. As indicated in Table B.11, the crash rates for all crashes and probable access-related crashes were higher for Segment One compared to the other segments. Segment One had a crash rate of 2.38 for total crashes and 1.25 for the probable access-related crashes. This means that there are 2.38 crashes per million miles for the total crashes and 1.25 crashes per million miles for probable access-related crashes.

Table B.11. Crash rates by segment (1997-2000)

	Segment One	Segment Two	Segment Three
Total Crash Rate	2.38	0.62	0.15
Probable Access-Related Crash Rate	1.25	0.25	0.03

*Per million vehicles

All the total and access-related crash rates shown in the tables above show a definite crash trend related to urbanization and land use on the Iowa 163 corridor. Segment One, the most urbanized segment, showed higher total and probable access-related crash rates than the other segments, even though vehicle miles traveled were highest for Segment Three. The next most-highly urbanized segment (or developing, “fringe” segment), Segment Two, also had the next-highest crash rates. Segment Three had a significantly lower total crash rate than Segment Two and a probable access-related crash rate near zero. These crash rates show that Segment One currently has a modest problem with probable access-related crashes, Segment Two has a small problem with these crashes, and Segment Three does not have a problem at this time. There should be concern about Segment Two, however, in that it has considerable potential for future commercial land development.

Crash Severity

Analyzing crash locations, frequencies, and rates are beneficial in understanding safety issues on Iowa 163. In addition, determining the severity of crashes provides insight on the gravity of crashes and how they monetarily impact communities and drivers. Different levels of crash severity incur an estimated cost to society, and these costs can be totaled per corridor to provide an estimate of the monetary cost of these crashes on Iowa 163. The severity levels and their corresponding costs in dollars used for this study are: fatality crashes at $1 million each, major injury crashes at $150,000 each, minor injury crashes at $10,000 each, and possible injury or property damage only crashes at $2,500 each. These figures are adopted from the Iowa Department of Transportation.

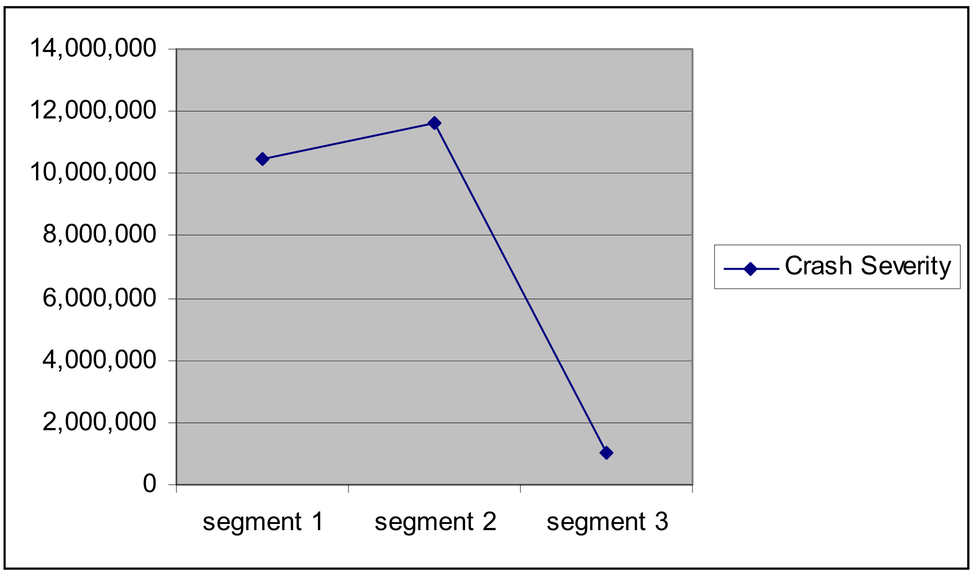


Figure B.27. Severity per segment for total crashes

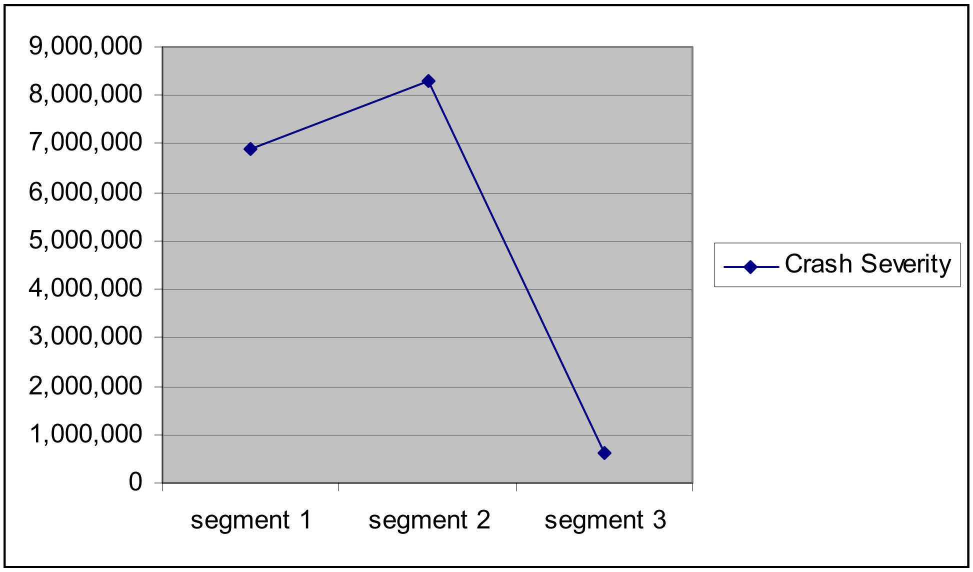


Figure B.28. Severity trends per segment for probable access-related crashes

The crash severity pattern shown varies from crash frequency pattern analyzed previously, which shows that the severity of crashes differed on each segment. In total and probable access-related crashes, Segment Two accrued the highest severity costs, with Segment One close behind. The reason of this is the higher travel speed on Segment Two; therefore, the crashes that occur there tend to involve more injury and property damage costs.

Access Rating

In March of 2002, the Center for Transportation Research and Education conducted a study "Process to Identify High-Priority Corridors for Access Management Near Large Urban Areas in Iowa." The results of the study indicate that Iowa 163 was ranked number five among 109 corridors analyzed in terms of access-related crash frequency. From 1997-1999, the total access-related crash frequency was 36 for Iowa 163 (Plazak and Souleyrette 2002).

The Iowa DOT maintains a priority ranking for access management on Primary Highways. The scale is as follows:

1. Access points allowed at interchanges only
2. Access points spaced at minimum of 800 meters
3. Access points spaced at minimum of 300 meters in rural areas and 200 meters in urban areas
4. Access points spaced at a minimum of 200 meters in rural areas and 100 meters in urban areas
5. The Department of Transportation has minimal access rights acquired
6. The Department of Transportation has no access rights acquired

A classification one would be the highest priority in terms of access management, and a classification six would be the lowest priority. Iowa 163 was ranked as category three from Pleasant Hill to Monroe. This means that access points can occur at a rate of about five access points per mile along rural areas and at a rate of about one access point per standard city block inside cities. Figure B.29, shows a map of access-controlled locations and their rankings for the state of Iowa.

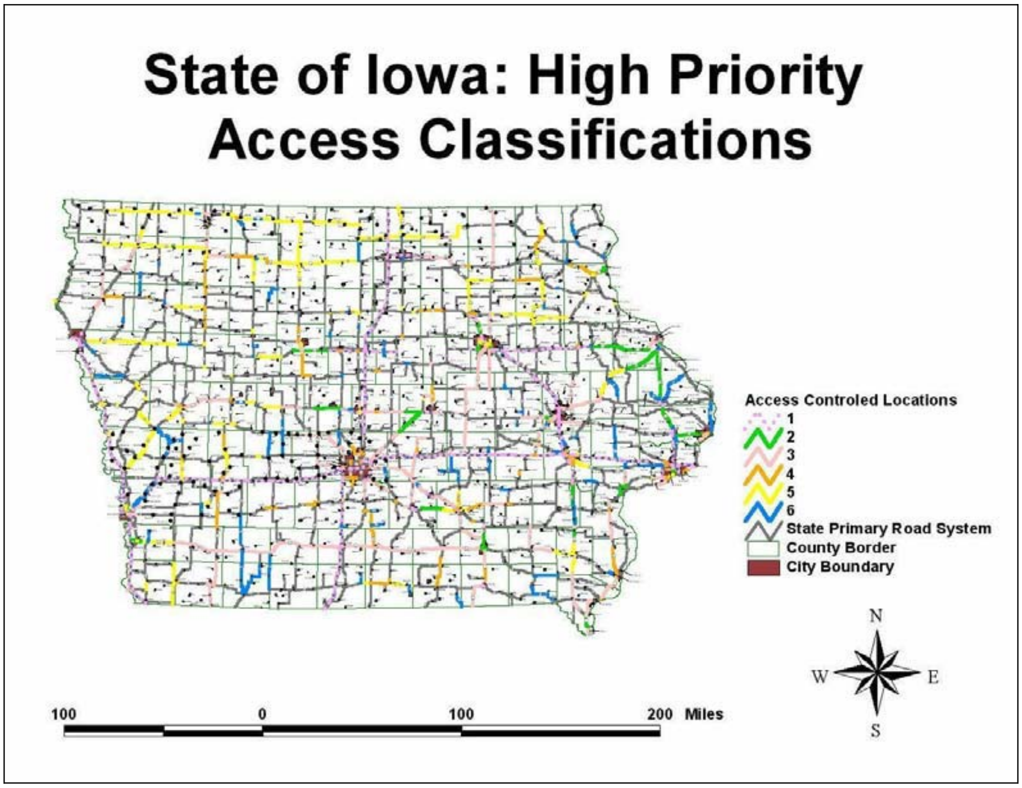


Figure B.29. Access ratings: State of Iowa

Corridor Management Plan for Iowa 163

Corridor One Specific Problems

Iowa 163 has modest access-related issues at present. However, because of a combination of increasing commuter traffic and increasing land development along the corridor, issues such as increased traffic congestion and access-related crashes are very likely to arise in the next twenty years along this corridor. A pro-active corridor management plan would be most helpful for this corridor.

The most pressing current issue along Segment One is the high amount of probable access-related crashes, particularly rear-end crashes. As shown previously, there is an abundance of rear-end collisions concentrated around the intersections of Williams Street, Copper Creek Road, Hickory Boulevard, and Northeast 56th Street. The severity of the probable-access crashes has been increasing since 1998 and totaled around $6,890,000 in damages. Figure B.30, shows the close distance of traffic signals from one another along Segment One. As shown, some of the signals are less than a half-mile distance from one another; which is a desirable minimum spacing for signals along an arterial corridor.

As shown in maps throughout this study, there is a high density of public road intersections along Segment One. The median is raised along Segment One with few median openings, except at intersections. Access-related accidents are more prone to occur in the areas where medians and intersections are located. At some major intersections, there are no turning lanes, which causes congestion and queues in traffic. Several of the intersections along Segment One are at or are approaching a traffic level of service (LOS) of D. A LOS of D or E at an intersection occurs where there is little maneuverability due to congestion, and a LOS of F is breakdown of traffic flow. This could be remedied for the most part along Segment One of IA 163 by adding turning lanes at the major intersections.

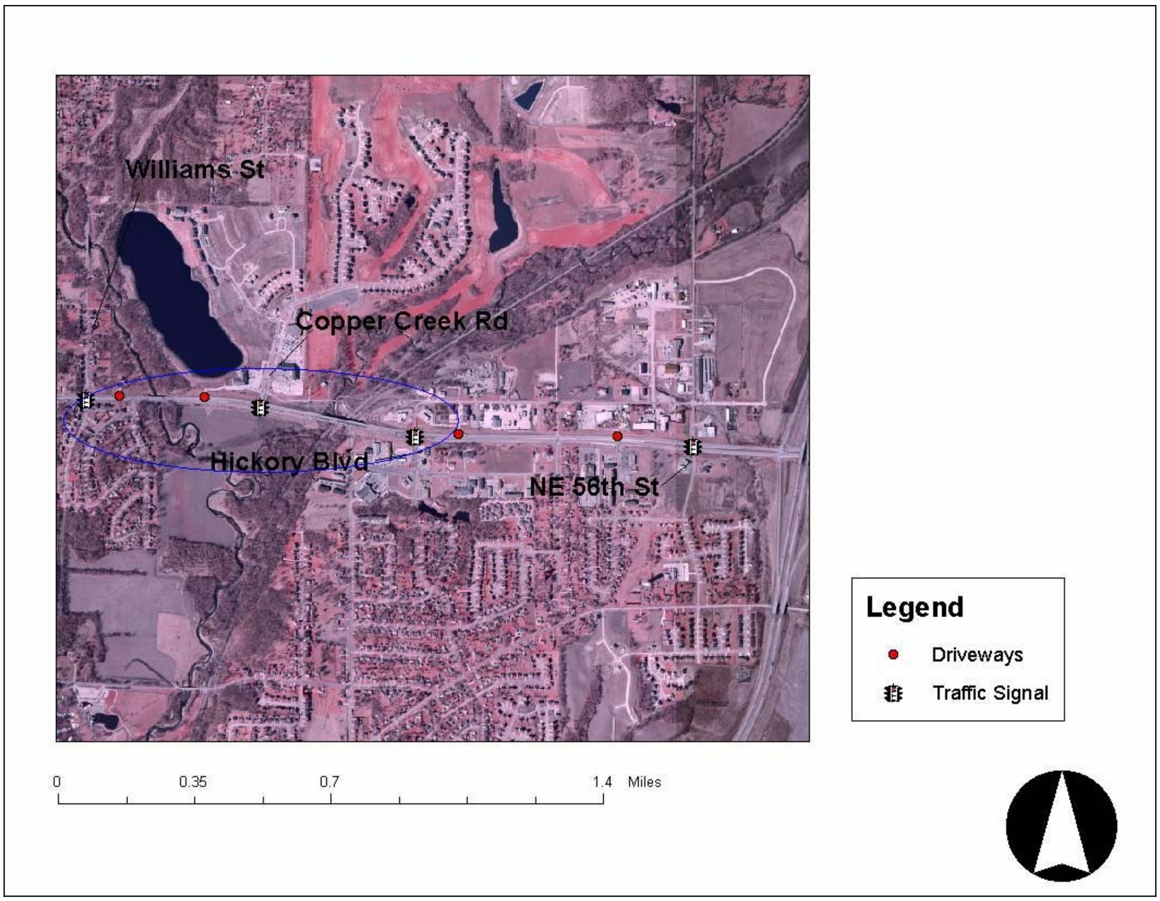


Figure B.30. Signal spacing less than 0.5 mile, Segment One

Low mean travel speeds are also an issue along Segment One. The posted speed limit along Segment One is 35-45 miles per hour. However, traffic tends to move at lower speeds. At peak hours, generally around 8-9 A.M. and 4-5 P.M., there is usually a higher volume of traffic (commuters) which slows the average speed. The amount of traffic and distance between signals and access points also tends to slow speeds along Segment One. Some of the signals are spaced less than 0.5 miles apart, which does not support a 35 to 45 mile per hour progression.

As shown previously, there are numerous commercial access points along Segment One. Ideally, these access points should not exist directly off Iowa 163; rather, there would be frontage or backage roads to allow drivers to access land parcels. Since the land use pattern is established and the area is built-out, redesigning commercial access would be difficult. It would be more feasible to relocate access points along frontage or backage roads or consolidate access points.

Possible Segment One Solutions

There are several locations where access can be improved along Segment One. The use of frontage or backage roads and shared driveways are possible solutions to these access problems. Frontage or backage roads are likely the best solution for Segment One because alternatives are limited since the land along this segment is already developed but some potential right-of-way exists. Figure B.31 shows an area for a possible frontage road from Copper Creek to eliminate direct access from Iowa 163 to the commercial parcel shown. The frontage road would span approximately 0.09 miles in length, eliminating one access point from Copper Creek Road, thus cutting down the access to only one location from Copper Creek Road. Figure B.31 shows another frontage road alternative, with access from the nearest driveway to Iowa 163 on Copper Creek Road. This frontage road is approximately 0.065 miles in length.

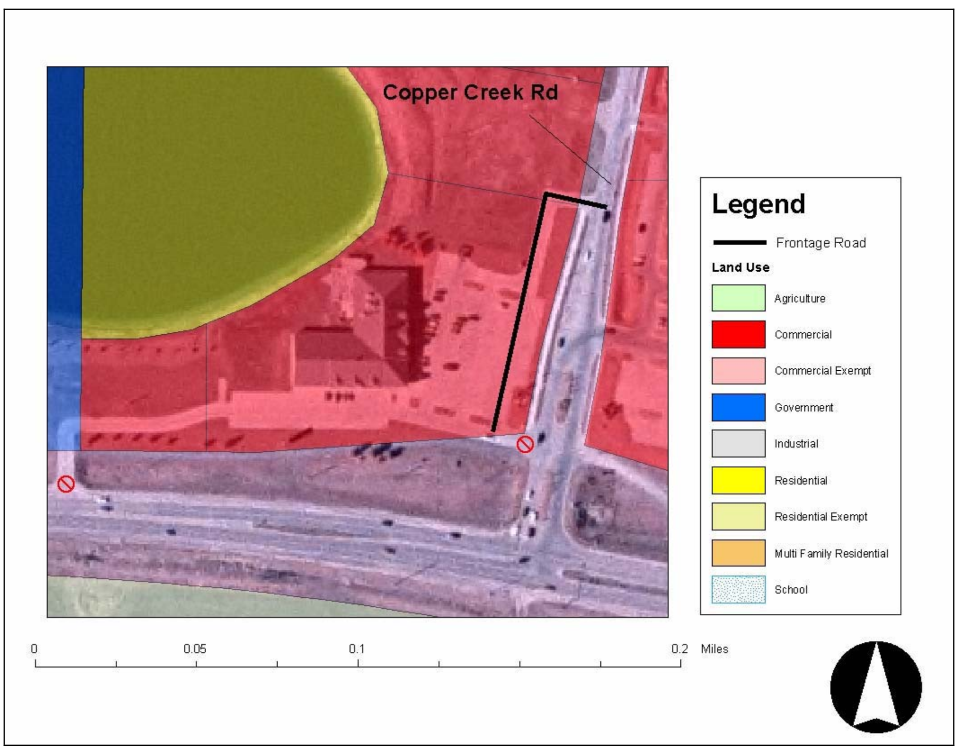


Figure B.31. Possible frontage road and access elimination, Segment One

Figure B.32 shows another possible frontage road location for Segment One, which is approximately 0.12 miles in length. The frontage road would provide access to the commercial parcels at 1125 Hickory Boulevard, 5015 University Avenue, and other parcels at the intersection of IA 163 and Hickory Boulevard. This would reduce the number of access points along Segment One of Iowa 163. Since there is no opening in the median, the driveway provides only right turn access for cars heading west from Iowa 163.

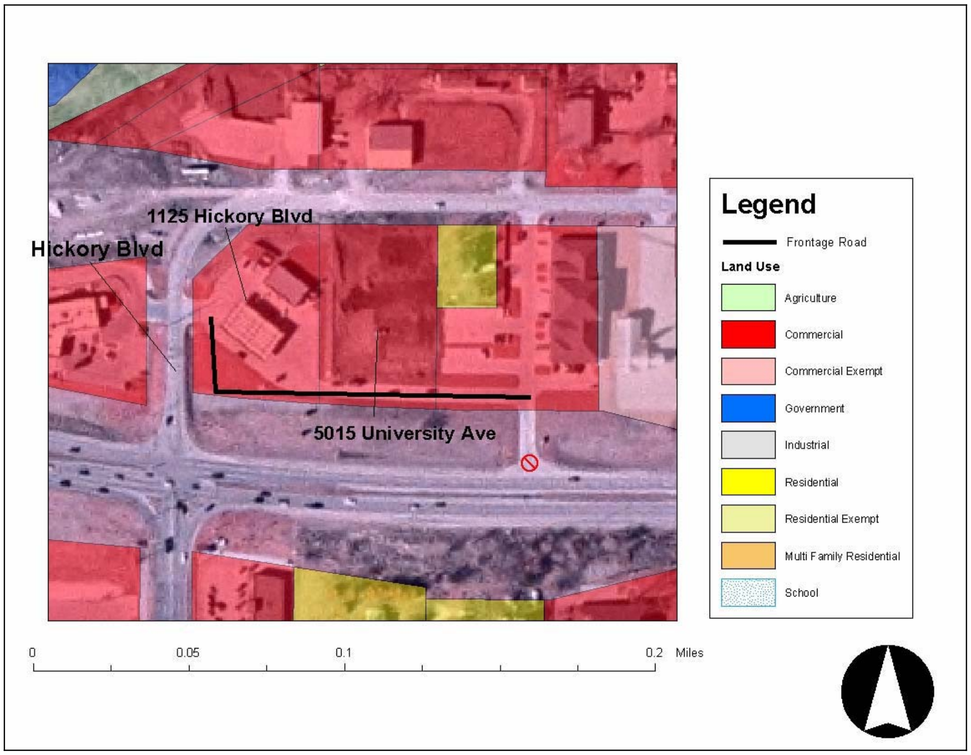


Figure B.32. Possible frontage road, Segment One

Another possible location for a frontage road is pictured in Figure B.33. It is located to the east of Shadyview Boulevard and north of Iowa 163. This frontage road would extend approximately 0.10 miles from Shadyview Boulevard to Whitewater University. The frontage road would eliminate the access location from Iowa 163 at Whitewater University. As the figure shows, the driveway to be eliminated provides full access, which could easily result in access-related crashes since many right, left, and straight movements could occur here.

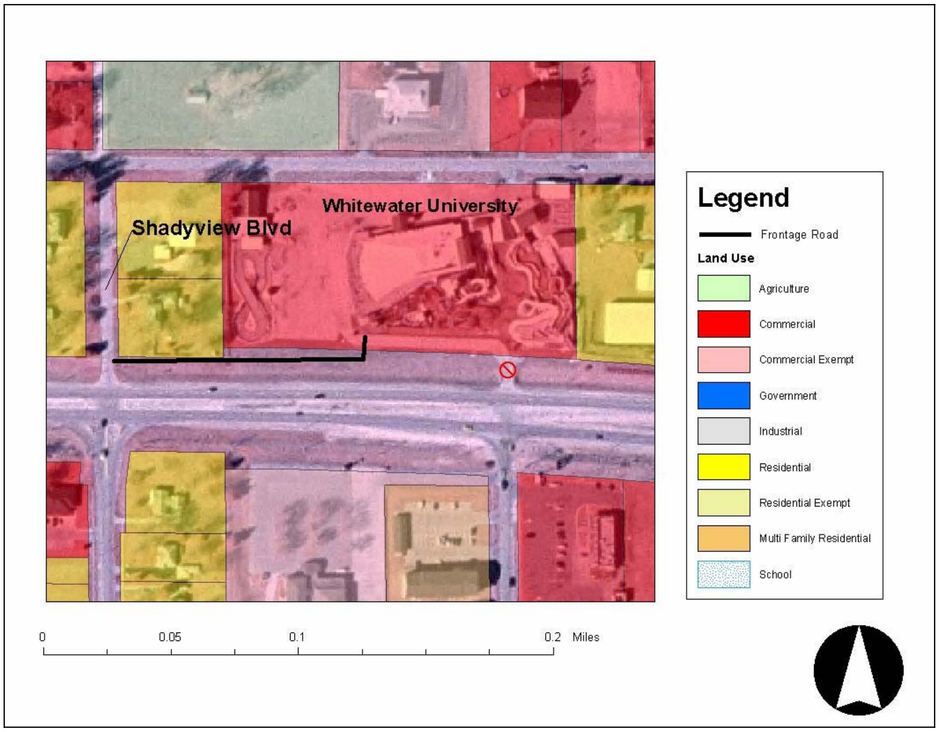


Figure B.33. Possible frontage road, Segment One

As shown earlier, many of the access-related crashes occurred at the major intersections along Segment One. To remedy this, turning lanes could be constructed. The addition of turning lanes could also improve the LOS at intersections, which could increase the average travel speed by separating turning traffic from through traffic.

Segment Two Specific Problems

There are many driveways along Segment Two of the study area, particularly in the area near Pleasant Hill (the western portion of Segment Two). One large concern for Segment Two is the potential transportation safety impacts if development were to continue to occur as designated by Polk County's future land use plan. The future land use indicates the expansion of commercial use from Segment One to Segment Two all the way to Northeast 70th Street. This would result in an extended "commercial strip" development along several miles of IA 163. Additional commercial use along Segment Two could have numerous negative transportation safety impacts on Iowa 163. Examples of negative impacts could include an increase in driveway density, demand for additional traffic signals and median breaks, lower average speeds, lower LOS, and increased access-related crashes.

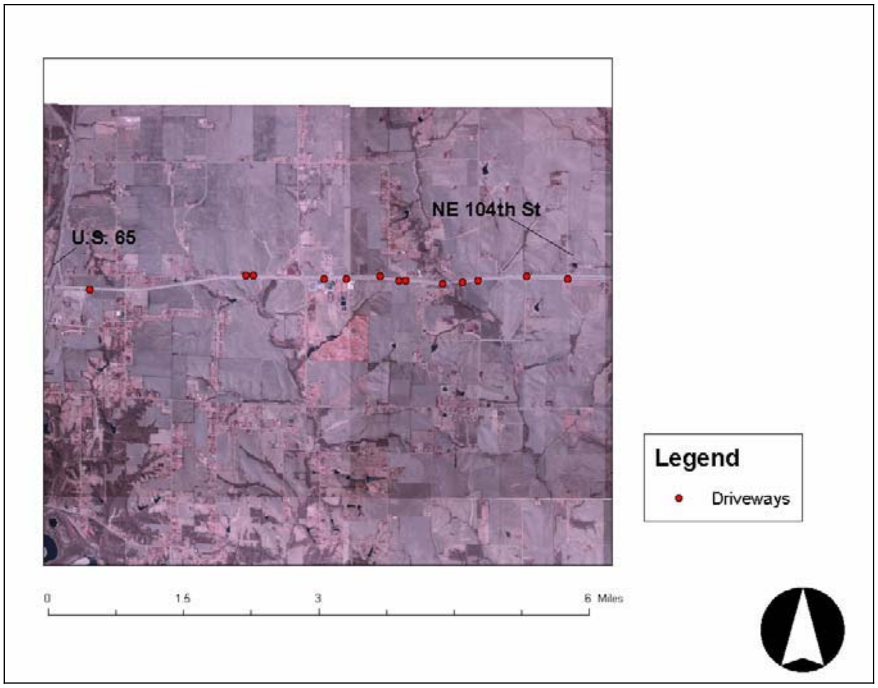


Figure B.34. Driveway locations, Segment Two (U.S. 65 to NE 104th Street)

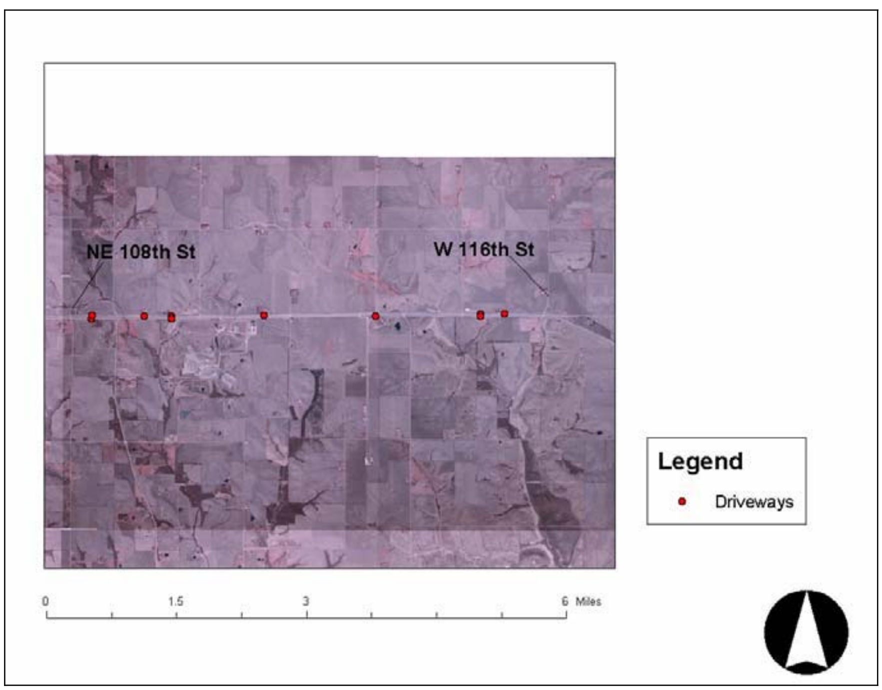


Figure B.34. Driveway locations, Segment Two (U.S. 65 to NE 104th Street)

Another issue of concern along Segment One is the current amount of access-related crashes, particularly rear-end crashes. There are numerous intersections that are of concern in this regard, especially if further commercial development occurs in the future. There are a few right-turn crashes at Northeast 64th Street, as shown in Figure B.35

below. Northeast 70th and Northeast 80th Streets are other locations where right turn crashes have occurred along segment two. The right turn crashes at Northeast 80th Street could be caused by the heavy traffic before or after school hours at Southeast Polk High School. As shown in the Figure B.37, there is a gate accessing Southeast Polk High School from Iowa 163. Refer to figures B.35, B.36, and B.37 below to see locations of right turn crashes along Iowa 163. The probable access-related crashes along this segment are of concern because, as noted before, the crash severity was highest for this segment with a total of $8,287,500 for probable access-related crashes.

Figure B.35. Right-turn crashes at NE 64th Street

Figure B.36. Right-turn crashes at NE 64th Street

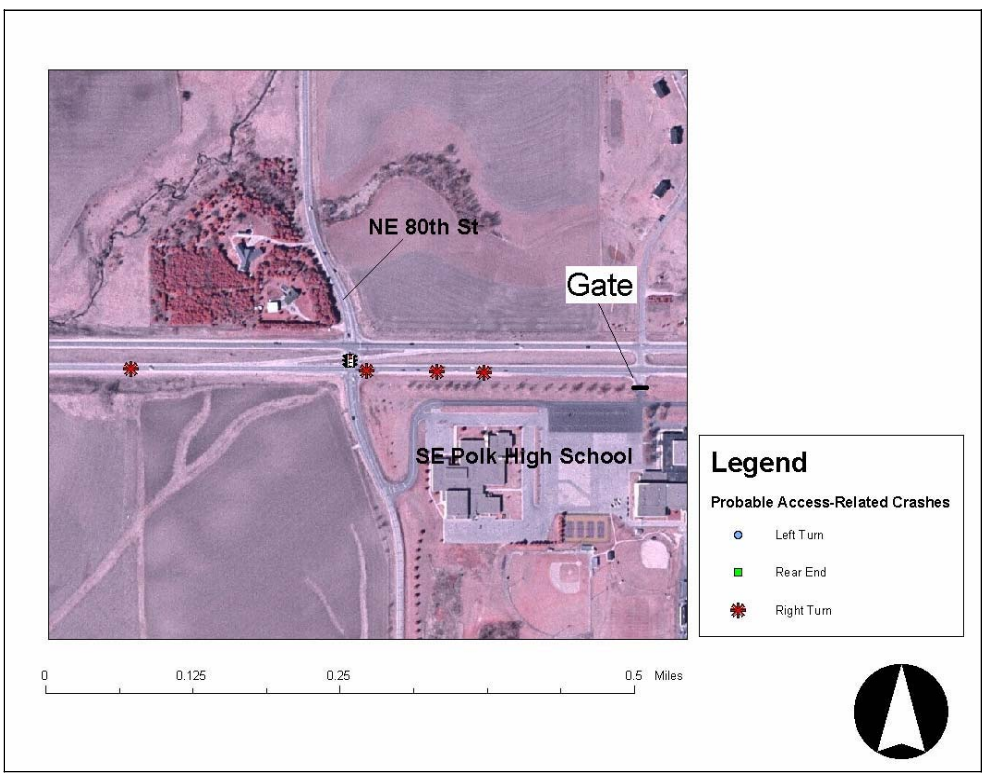


Figure B.37. Right-turn crashes at NE 80th Street (near southeast Polk high school)

Segment Two solutions

There are several locations where access can be improved along Segment Two. Frontage or backage roads and shared driveways could also be used to eliminate selected access locations along Iowa 163. Figure B.38 is an example of sharing driveways to limit access points along Iowa 163. The shared driveway shown here would provide access to the residential parcels of 7504 University Avenue and 7598 University Avenue and eliminate the current driveway at 7598 University Avenue.

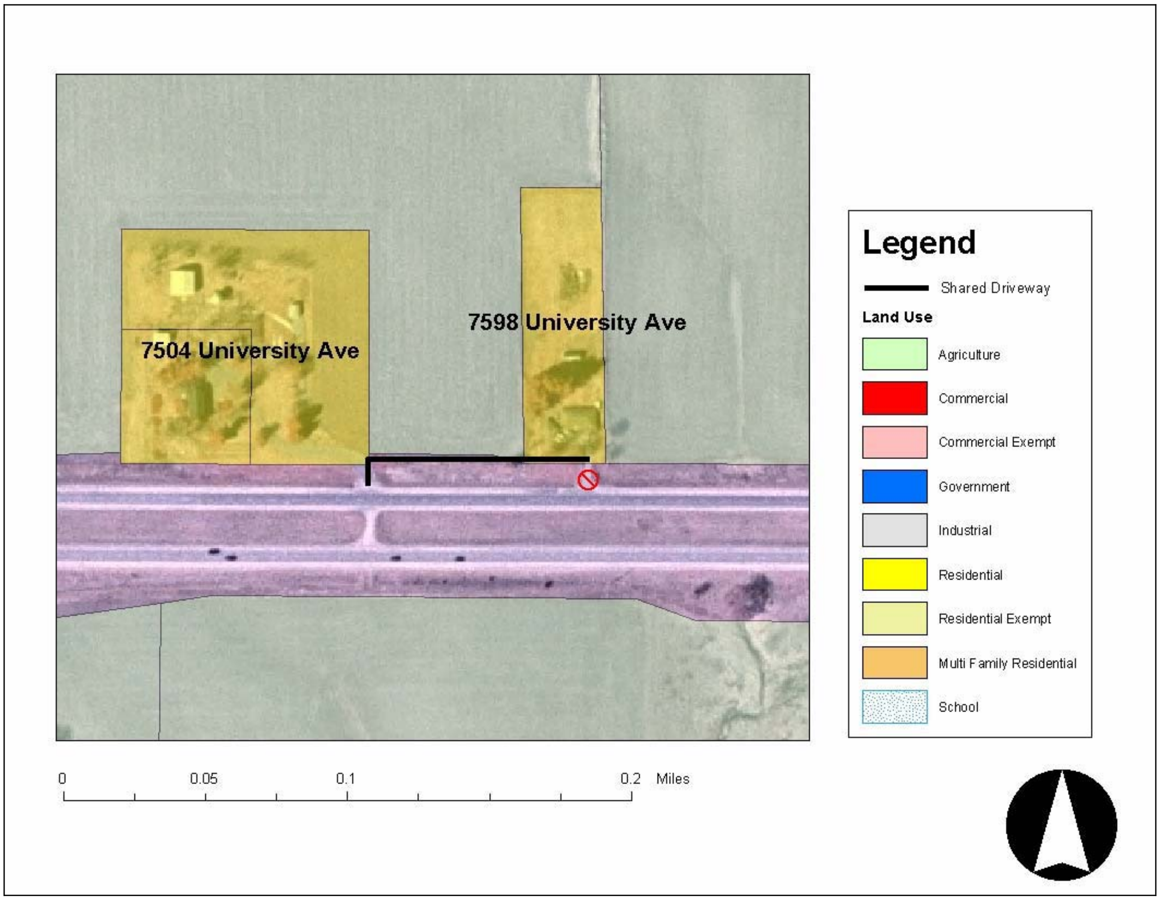


Figure B.38. Shared Driveways, Segment Two

A possible frontage road is shown below in Figure B.39. This would relocate the access point from Iowa 163 to West 124th Street, thus eliminating access from Iowa 163. The frontage road would span only 0.09 miles from West 124th Street to the commercial property of 12372 Iowa 163.

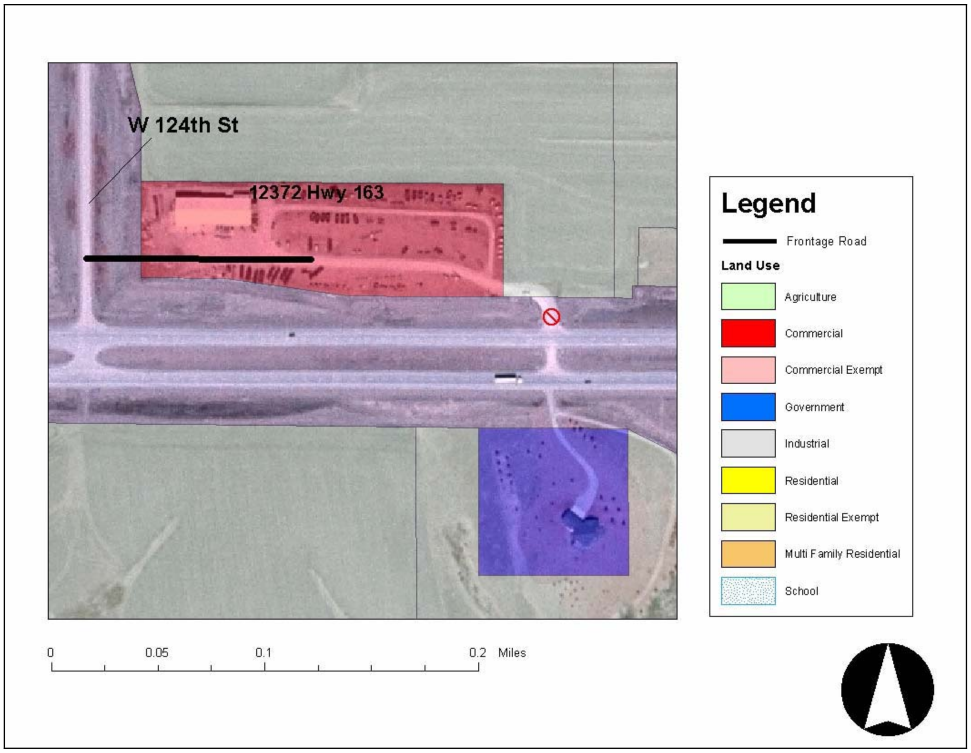


Figure B.39. Possible frontage road and access elimination: alternative A, Segment Two

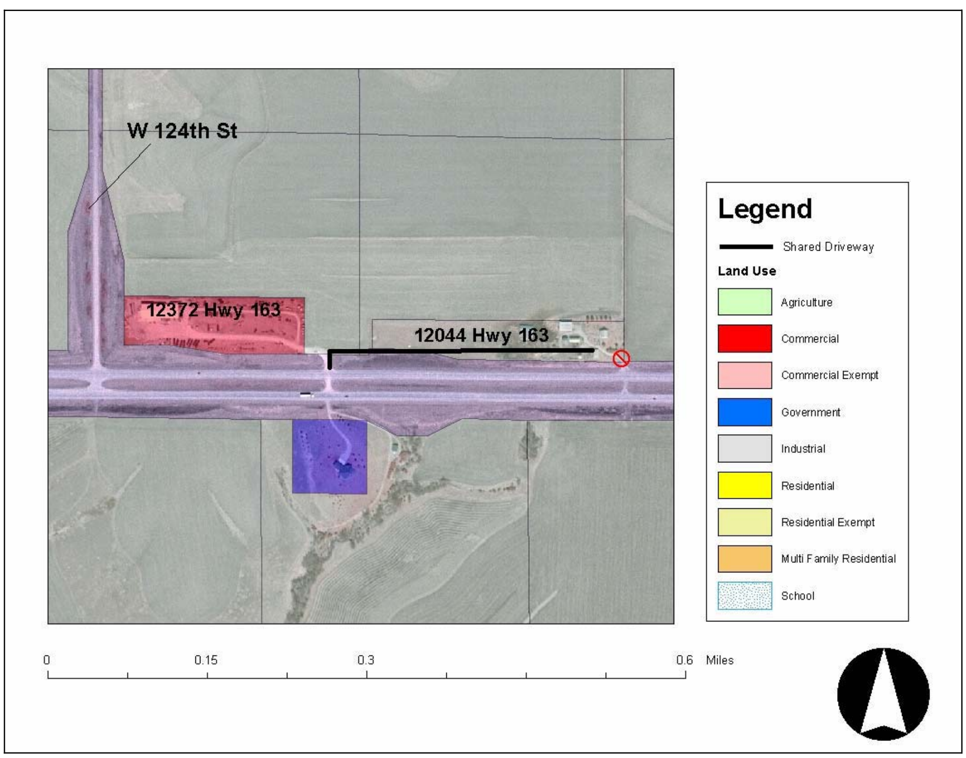


Figure B.40. Possible frontage road and access elimination: alternative B, Segment Two

Figure B.41 shows an example where residential access to Iowa 163 could be eliminated. This residential parcel is located to the north of Southeast Polk High School. As shown in the figure, there are two driveways providing access to 8308 University Avenue. The driveway that provides access from Iowa 163 could be eliminated.

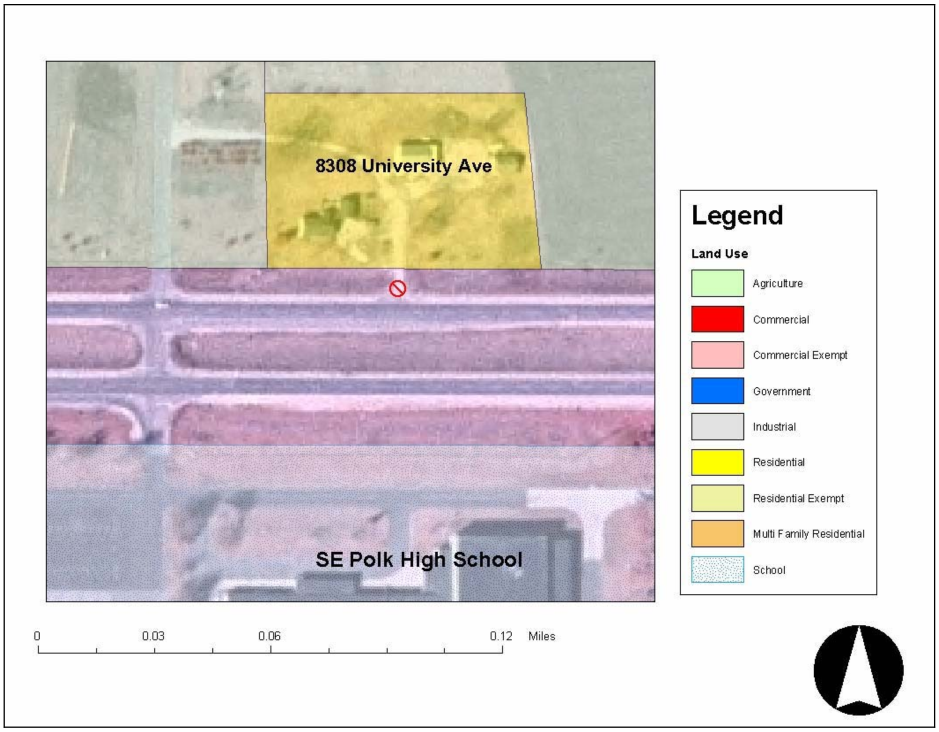


Figure B.41. Possible access elimination, Segment Two

Segment Two of IA 163 would be, because of the real potential for access-related problems in the future, an excellent location for the development of an intergovernmental corridor management agreement such as has already been developed along US Highway 6 in the western suburbs of Des Moines. This agreement is shown in Appendix C of this report.

Segment Three Specific Problems

Currently, Segment Three, the primarily rural part of the corridor, does not have any troublesome access-related issues at present. There is hardly any commercial land use along this segment and there are no traffic signals. In addition, there are few probable access-related crashes for Segment Three. This can be attributed to the fact that there are no commercial driveways providing direct access from Iowa 163.

Segment Three Solutions

The best strategy for Segment Three would be to preserve the lack of access points here, so that conditions from Segment Two would not extend into this area in future years. This could best be done by carefully controlling access points through the driveway permitting process and by encouraging coordinated land use planning by Polk and Jasper Counties and by the cities along this segment of the corridor.

APPENDIX C: IOWA DOT CORRIDOR MASTER PLAN AGREEMENT EXAMPLE

(Note: Provided For Illustrative Purposes Only)

Corridor Master Plan
U.S. 6 Corridor
Dallas County, Iowa
Agreement No: xxx-xx-xx

This U.S. 6 Corridor Master Plan, hereinafter referred to as the "Plan", is entered into by and between the Iowa Department of Transportation, hereinafter referred to as the "DOT", the City of Clive, Iowa hereinafter referred to as "Clive", the City of Urbandale, Iowa hereinafter referred to as "Urbandale" and the City of Waukee, Iowa hereinafter referred to as "Waukee".

WHEREAS, the purpose of this plan is to define parameters for transportation management, access management, land use and development characteristics along the U.S. 6 highway corridor within the limits defined. The designated corridor extends from Interstate 35/80 (I-35/80) on the east extending westerly to the west corporation limits of Waukee.

WHEREAS, it is not the purpose of this Plan to identify specific projects, rather, its purpose is to establish guidelines which shall promote safe and efficient traffic flow and which shall enhance and sustain economic development along the corridor. The Cities shall be able to use this Plan as a tool for managing economic development along U.S. 6.

NOW, THEREFORE, IT IS AGREED as follows:

1. **The general standard for management of the U.S. 6 Corridor are as follow:**

   A. **PLANNING**

      1) Future fully directional access to U.S. 6 shall be limited to public road connections at ¼ mile spacing (see Exhibit "A" attached). Other direct accesses to U.S. 6 may be authorized as right in right out only. All other access shall be provided from other public roads. Remaining U.S. 6 frontage shall be access controlled.

      2) Access connections along U.S. 6 may be required to have appropriate acceleration and deceleration lanes, tapers and other appropriate geometric features to insure that the impacts of the adjoining development are fully mitigated. Fully directional access connections may also include appropriate left turn storage where necessary.

      3) Access road concepts shall be initiated in the platting stage of each industrial/retail development activity. Access roads which are constructed shall

be offset from the U.S. 6 centerline.

4) All traffic signal construction, within the defined corridor, must conform to 800 meter (½ mile) spacing requirements.

B. **OPERATIONS**

1) Existing access connections may be required to have appropriate acceleration and deceleration lanes, tapers and other appropriate geometric features to insure that the impacts of the adjoining development to U.S. 6 are fully mitigated. Fully directional access connections may also include appropriate left turn storage where necessary.

2) Additional access control may be obtained where necessary.

2. The general parameters for implementation of the U.S. 6 Corridor Master Plan.

A. It is understood that this Plan may be appended, amended or vacated by the written agreement of all signatory parties.

B. It is further understood that this Agreement and all contracts entered into under the provisions of this Agreement are binding upon the DOT and the Cities as defined herein.

C. The Cities agree to adopt all necessary ordinances and/or resolutions and to take such legal steps as may be required to give full effect to the terms of this Plan.

D. The DOT and the Cities, as defined herein, will meet on an annual basis to review and evaluate this Plan. The DOT will coordinate this meeting by determining the date and location along with gathering input from the Cities for preparation of the agenda.

E. No third parties beneficiaries, are intended to be created by this Agreement, nor do the parties herein authorize anyone not a party to this Agreement to maintain a suit for damages pursuant to the terms of provisions of this Agreement.

IN WITNESS WHEREOF, each of the parties hereto has executed Agreement No. xxx-xx-xxx as of the date shown opposite its signature below:

CITY OF CLIVE:

By: ___________________________________ Date__________________________, 200____.
Title: Mayor

I,_____________________________________, certify that I am the Clerk of the CITY, and that

________________________________, who signed said Agreement for and on behalf of the CITY

was duly authorized to execute the same on the ____ day of _______________, 200____.

Signed _____________________________

City Clerk of Clive, Iowa.

CITY OF URBANDALE:

By: ___________________________________ Date__________________________, 200____.
Title: Mayor

I,_____________________________________, certify that I am the Clerk of the CITY, and that

________________________________, who signed said Agreement for and on behalf of the CITY

was duly authorized to execute the same on the ____ day of _______________, 200____.

Signed _____________________________

City Clerk of Urbandale, Iowa.

CITY OF WAUKEE:

By: ___________________________________ Date__________________________, 200____.
Title: Mayor

I,_____________________________________, certify that I am the Clerk of the CITY, and that

_______________________________, who signed said Agreement for and on behalf of the CITY

was duly authorized to execute the same on the ____ day of _______________, 200____.

Signed _____________________________

City Clerk of Waukee, Iowa.

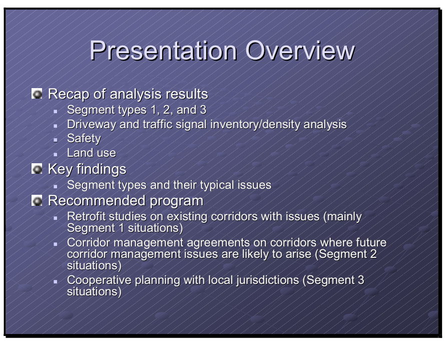
IOWA DEPARTMENT OF TRANSPORTATION:

By:________________________________ Date_____________________________, 200____.
District Engineer
District 4.

APPENDIX D: PRESENTATION OF THE STUDY TO THE IOWA DOT'S HIGHWAY DIVISION MANAGEMENT TEAM

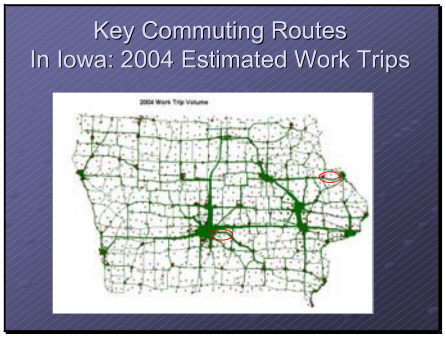
Slide 1

Slide 2



Slide 3

Slide 4



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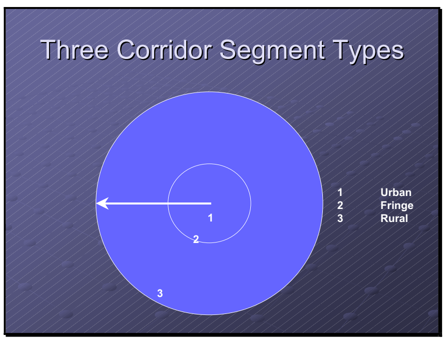

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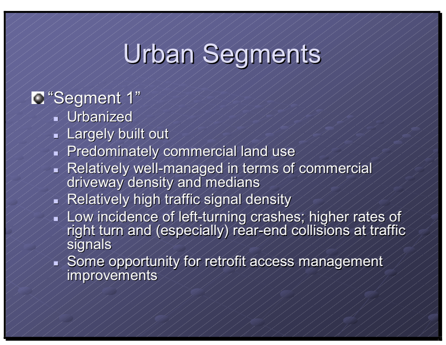


Slide 7

Fringe Segments

- "Segment 2"
  - Urbanizing (suburban and urban fringe)
  - Largely undeveloped
  - Considerable land development potential
    - Likely use: mixture of commercial, industrial, and large lot residential
  - Relatively well-managed in terms of commercial driveway density and medians at present
  - A few traffic signals at major intersections or ramps
  - Low incidence of left-turning crashes; higher rates of right turn and rear-end collisions
  - Considerable potential for *future* access management problems

Slide 8

Rural Commuter Route Segments

- "Segment 3"
  - Rural, but within 30 minute commuter range
  - Largely undeveloped
  - Predominately agricultural land use
  - Relatively well-managed in terms of commercial driveway density and medians
  - No traffic signals
  - Low incidence of left-turning crashes; low rates of right turn and rear-end collisions
  - Opportunities for "spot" access management at a few locations

Slide 9

Example Analysis Results: US 20

- Driveway locations and density
- Traffic signal location and density
- Safety: crashes frequency, type, and rate
- Land use: present and future

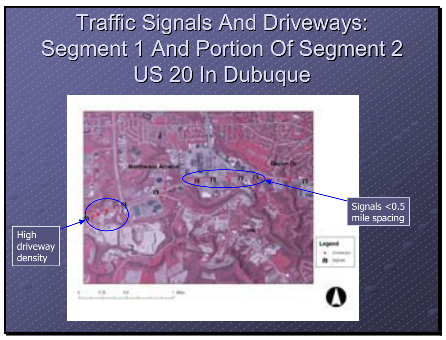
Slide 10

Driveway Density Analysis: US 20

	Segment Length	Driveway Count	Driveways/ Mile
Segment 1	2.0 miles	9	4.5 (low)
Segment 2	8.0	30	3.8 (low)
Segment 3	15.8	5	0.3 (very low)

Segment 2 has several instances of moderate density.

Slide 11



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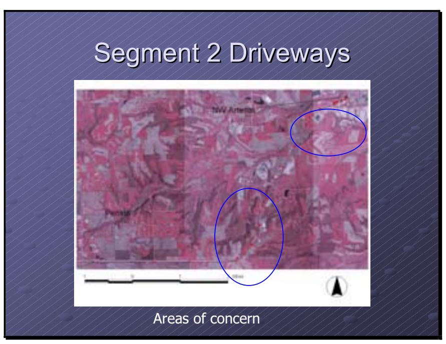

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Segment 3 Driveways

Very well managed segment

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Safety Analysis

- Crash frequency
  - Focus on access-related crashes
  - Left-turn, right-turn, and rear-end collisions
- Access-related crash rates
- Access-related crash severity

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Current Safety Analysis US 20: Access-Related Crashes

	Segment 1	Segment 2	Segment 3	Corridor
Rear End	67 (35%)	27 (25%)	0 (0%)	94 (26%)
Right Turn	18 (9%)	8 (7%)	1 (2%)	27 (7%)
Left Turn	1 (1%)	3 (3%)	3 (5%)	7 (2%)
All Access-Related	86 (44%)	38 (35%)	4 (6%)	128 (35%)
Total Crashes	194 (100%)	108 (100%)	64 (100%)	366 (100%)

Note: Columns do not total to bottom number. Difference is non-access crashes.

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Access-Related Crash Rates US 20

	Segment 1	Segment 2	Segment 3
Access-Related	4.2 (Moderate)	1.5 (Low)	Near Zero

Probable access-related crash rates per million vehicle-miles traveled. Includes right-turn, left-turn, and rear-end collisions.

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Crash Hot Spots: Segment 1 Rear-End Collisions Predominate

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Safety Analysis For US 20: Conclusions

- **Overall**
  - Roughly 35% of all crashes in the corridor are access-related, but these are concentrated in the urban and suburban portions (Segments 1 and 2)
  - Access-related crashes tend to be severe
  - Driveway densities are generally not high on the route, but there are several concentrations of commercial driveways that could be consolidated
- **Segment 1**
  - Has significant numbers of rear-end collisions and right turn crashes
  - This is consistent with a multilane divided corridor with a high public road intersection density and high traffic signal density
- **Segment 2**
  - Has a less significant access-related safety problem than Segment 1
  - There are three problem sub-segments
  - Some safety problems are associated with public road intersections rather than with driveways
- **Segment 3**
  - Safety problems are generally not access-related (crashes are run off the road, weather-related, animal crashes, etc.)

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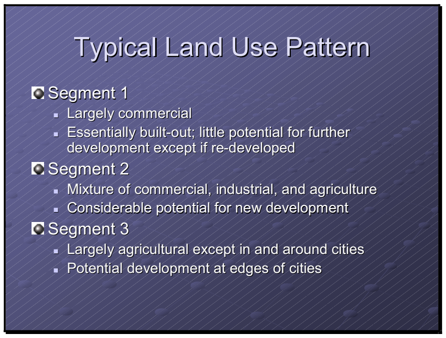

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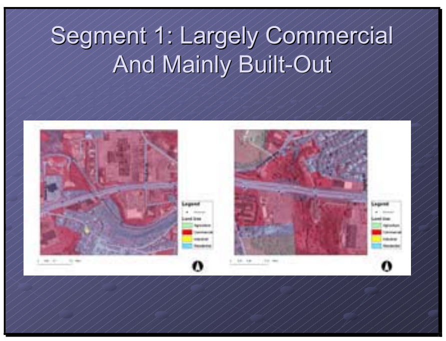

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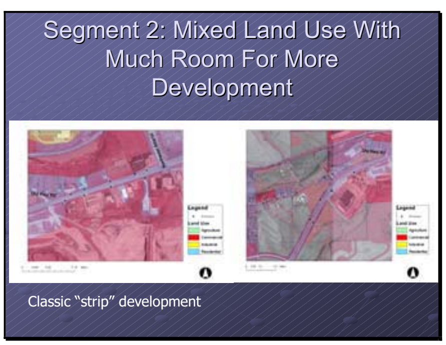
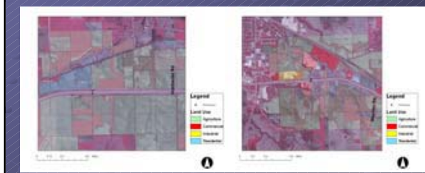


Slide 22

Segment 3: Mainly Agricultural With Mixed Use Near Cities



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Future Land Use Analysis: US 20

- Segment 1 will continue to exist as a commercial strip with some changes in individual parcels and businesses
- Segment 2 will continue to develop as a commercial/industrial strip (eastern half) and large lot residential (western half)
  - This segment has (by far) the most potential for future land development
- Segment 3 will remain largely agricultural except in and near Peosta, Epworth, Farley, and Dyersville

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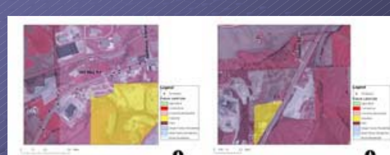
Segment 2: Planned Industrial Development



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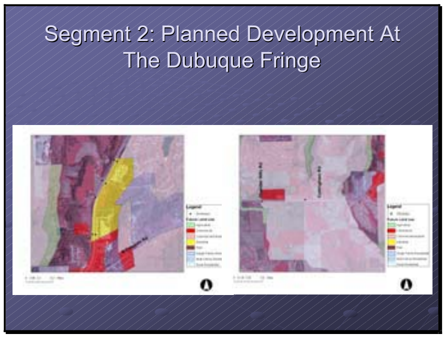

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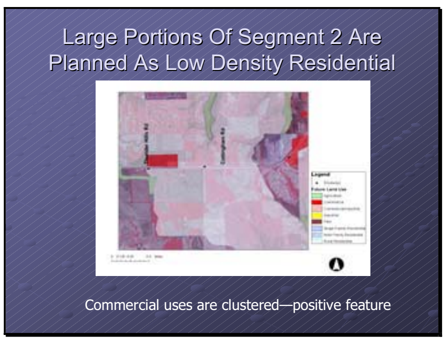

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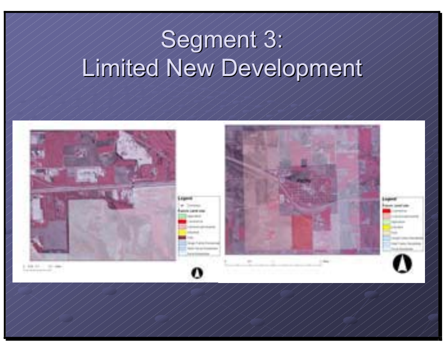

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Typical Current Corridor Management Issues By Segment Type

- Segment 1
  - High density of public road intersections and median breaks
  - High density of traffic signals
    - Close spacing leads to a decline in mean travel speed, loss of LOS, and an increase in rear end collision rates
  - Lack of dedicated turning lanes at major intersections
  - Discontinuous frontage road system
    - Frontage road system too close to the mainline
  - Some direct driveway accesses that could be closed or consolidated

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Typical Corridor Management Issues By Segment Type

- Segment 2
  - Several areas with direct driveway accesses that could be closed or consolidated
  - Areas of high crash rates that are usually related to land development and access decisions
  - Discontinuous frontage road system
  - Large potential for future access management issues as land develops
    - Especially important in areas slated for commercial and industrial development

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Typical Corridor Management Issues By Segment Type

- Segment 3
  - "Spot" safety issues associated with individual developments
  - Examples:
    - SE Polk High School and Des Moines Metro landfill on IA 163
    - Farley and Epworth area existing and potential development on US 20
    - BMX facility on US 20

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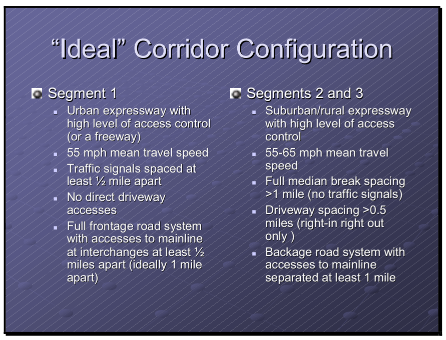

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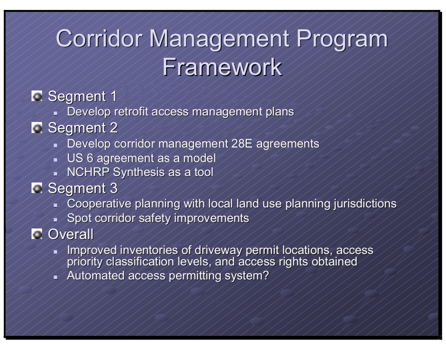

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Specific Items That Should Be Addressed In A Retrofit Access Management Study

- Segment 1 Situations
  - Inventory: driveways, medians,
  - Safety analysis: crash rates, locations, and types
  - Present and future land use
  - Traffic signal location and spacing
  - Improved traffic control systems
  - Dedicated turning lanes
  - Frontage or backage road system and internal circulation in adjacent developments
  - Consolidation and clearance of commercial driveways

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Specific Items That Should Be Included In A Corridor Management Agreement

- Segment 2 Situations
  - Public road interchanges and intersections
  - Traffic signal locations
  - Medians and median breaks
  - Driveway locations and directions (e.g. right-in, right-out)
  - Dedicated turning lanes
  - Alternative access ways (e.g. development of frontage and backage road systems)
  - (The US 6 agreement: Iowa DOT District 4, Clive, Urbandale, Waukee is a good model)
  - (NCHRP Synthesis report to be published this year)

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Specific Items That Should Be Pursued In Rural Parts Of Corridors

- Segment 3 Situations
  - Some communities along key commuting corridors have no comprehensive land use plans or badly outdated plans
    - Encourage them to develop and update plans
  - Cooperatively review new development proposals for potential access and safety issues, especially those that involve commercial and industrial development
  - Conduct “spot” safety and access analyses at current and potential problem locations

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Miscellaneous Program Items

- Improved inventories would be helpful
  - Location of driveways
    - We were able to do an accurate inventory in the Des Moines metro area with color digital orthophotography
  - Access priority classification system cleanup
    - Where are access rights held by Iowa DOT?
- Kansas DOT is developing an automated driveway management permitting system that will promote more consistent processing of requests and help increase adherence to standards

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Expected Benefits Of A Corridor Management Program

- Preservation of the Iowa DOT's multi-million dollar investments in major corridors
- Maintain mean travel speed and LOS, especially on Segment 1s
- Lower rear-end collision rates (mainly on Segment 1s)
- Lower right and left turning crash rates (mainly on Segment 2s)
- Preservation of Segment 3s, which are generally well-managed and safe now
- Maintenance of business environment on Segment 1s, which might otherwise begin to suffer due to higher travel times and greater congestion